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CITY COUNTY STATE

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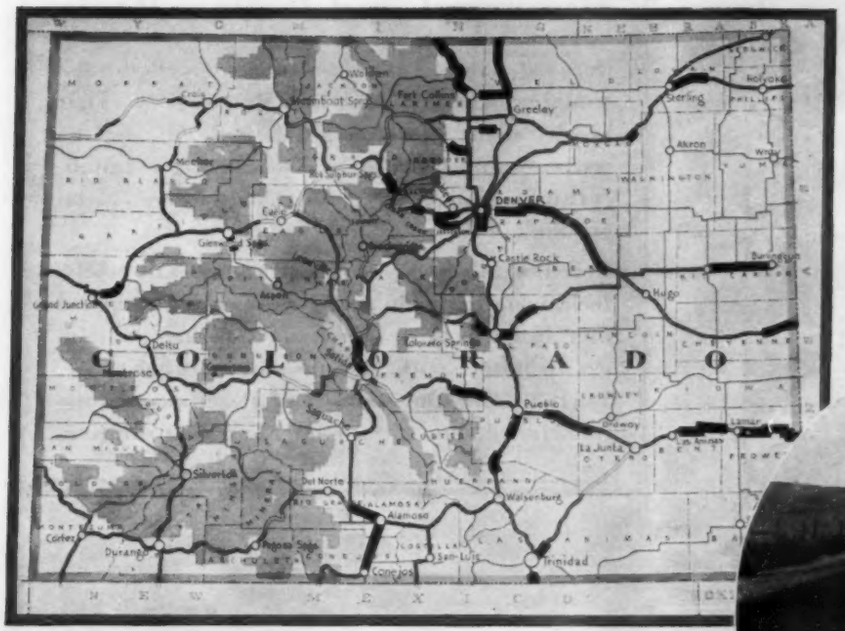
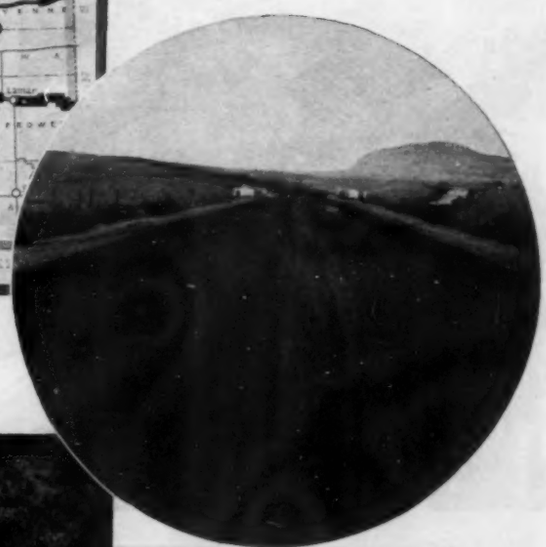
AUGUST, 1933

Colorado Highway is Constructing an System . . .





Do you make full use of the Readers' Service Dept.?—see pp. 47-50

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PUBLIC WORKS

An Engineering and Construction Journal

City County State

VOL. 64 AUGUST, 1933 No. 8

TABLE OF CONTENTS FOR AUGUST, 1933

PUBLIC WORKS

J. T. MORRIS, *President*
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Brainstorms

Correspondence:

Says Don T. Hastings: "I am much interested in knowing whether Ikey's little brother, Izzy, is still in the hospital. You know he got so dizzy turning around for his shorter and shorter trips between Mikey & Ikey that they finally had to call in the doctor." He's OK, again, thank you, Mr. Hastings. An old friend Leo Besozzi, in sending in a simple solution to the same problem, says: "Whatever became of the spider problem?

Here It Is:

For the benefit of those who missed it, it ran like this: A spider sits in the center of his web which is composed of eight radial threads and four concentric threads, waiting for the inevitable fly. When the fly lands at a junction of the threads, how many routes are open to the spider to reach the fly along the threads of his web, without crossing a junction more than once on any trip? Who among our experts besides Mr. Besozzi wants to tackle it?

Number, Number:

Recently we ran a problem about five numbers that would add up to and multiply together to get the same number in either case. This one is on the same order but simpler and is accredited to the famous Sam Lloyd. There are four whole numbers. Their sum is equal to their product. Which numbers are they?

Page the NRA:

The recovery program is working. Both prices and wages are increasing steadily at the rate of five percent per week. (Don't take all this too seriously, after all it's only a brainstorm.) If a workman can earn enough for one week's labor to finance himself for a week and a half at the prevailing prices, how long must he work to save up enough to pay all expenses during a two weeks' vacation?

Solutions:

The solution to the Chicken problem is comparable to that for the students which appeared in this column some time ago.

Received by	E	a	
Left by	D	5a	(a = 4b)
Received by	D	5b	
Received by	dog	4	
Left by	C	25b + 4	(b = 4c)
Received by	C	25c + 1	
Received by	dog	1	
Left by	B	125c + 6	(c = 4d + 2)
Received by	B	125d + 64	
Left by	A	625d + 320	(d = 4e)
Received by	A	625e + 80	
Total in flock		3125e + 400	

When e is equal to 0, the total number in the flock is 400. Other numbers satisfying the problem are 3525 (when e is equal to 1) 6650 (when e is equal to 2) etc.

For "cuteness" we like last month's problem about the Chicago fair trains. The one from Chicago covered 200 miles in the time that the other train travelled D-200 (D is the distance between towns) and also travelled D + 300 while the other train travelled 2D-300. From direct proportions, the distance between towns is 300 miles and therefore the train which left Chicago travelled 200 miles to the other's 100. It therefore travelled twice as fast as the other train, whose speed was 25 mph.

BENJAMIN EISNER.

Do you make full use of the Readers' Service Dept.?—see pp. 47-50

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 64 — *August, 1933* — No. 8

The Organization for Distributing That Three Billion Is Now Ready: Use It At Once

WE have become so accustomed to quick work in Federal matters since March 4th that many were inclined to feel that there was inexcusable delay in beginning actual payments from the $3,300,000,000 appropriated by Congress for public works, especially in making loans therefrom to "States, municipalities or other public bodies." But the Industrial Recovery Act was passed June 13th, and within only seven weeks since then the necessary personnel, Federal, regional and State, has been appointed and the detailed regulations adopted for controlling the expenditures of this enormous sum to the end that it shall secure most effectively a widespread provision of jobs for the unemployed, while securing to the Federal government the repayment of loans made to such public bodies.

These preliminaries have now been completed, and under date of August 1st, the Federal Emergency Administration of Public Works issued its Circular No. 2 giving "Information required with applications for loans to States, counties, municipalities, and other public bodies." A few days previous it announced the names of the members of the State regional advisory boards, which are instructed "(a) To stimulate the submission of projects, (b) to inform the public of the classes of projects eligible for the benefits of the act and to pass upon and report immediately all applications received.

This class of allocations of the public works fund necessarily involved more delay than the others. The $400,000,000 road fund was distributed among the states some time ago and actual construction work under it is beginning. (How the several states are spending these grants is described at length on page 30 of this issue). By August 1st $623,966,201 had been allocated to public works under the several Federal Departments (this including $100,000 for a survey of underground water resources and $2,400,000 for topographical surveys) and this work also is beginning. Moreover, the State advisory boards are instructed that "the immediate program shall include only such projects as can be started within 30 days," and actual payment of wages from this part of the appropriation also should be making its dent in the unemployment situation before September 1st.

It is probable that what is now of most interest to the readers of PUBLIC WORKS is the matter of loans and grants to public bodies, for what purposes they can be obtained, and how to apply for them. This is explained in detail in the 22 pages of Circular No. 1 of the Public Works Administration, which we can not find space to even abstract, but which it is the duty of the several state advisory boards to furnish. However, it may be worth while to state some of the salient features.

The country is divided into ten "regions" with a "regional advisor" for each. These act as direct representatives of the P. W. A.

For each state there is appointed a "State Advisory Board"; *all applications and communications relative to grants and loans for public works should be made to them,* not to Washington. There are three members of each board (except 4 for Texas). (If you can not learn the names of the members for your state, we will supply them on request.)

There is also for each state a "State engineer (P.W. A.)" appointed and directed by the administrator, who is the executive officer of the State board.

Interest on the loans will be at 4%. Bonds should have a life dependant upon that of the project, seldom exceeding 30 years. If bonds can not be furnished, the Federal government may lease the project, holding title thereto until it is paid for.

Projects will be given priority as follows:

(1) Waterworks projects not unduly burdening the community with debt and necessary for its health and convenience; (2) sewer projects of the same character; (3) sewage-disposal projects sufficiently comprehensive to render a river or lake system, used by many communities, safe as a water supply, and other sewage-disposal projects; (4) other projects which, like the foregoing, are regenerative, i.e., tend to stimulate further projects, such as highways, bridges and tunnels, opening of new territory for homes and industry, projects for the transmission of electrical energy into territories not now served.

In estimating the cost of a project in connection with making application for a loan, do not forget to allow for the greater cost that will result from the requirements as to labor. These include: no convict labor; 30-hour week; good wages; preference to ex-service men and citizens of the locality, and use of human labor instead of machinery "consistent with sound economy and public advantage."

The government apparently has provided the machinery necessary for quickly placing in circulation this three billion dollars. Let every public official do his part by getting in touch at once with his State Advisory Board and arranging to bring part of this into his own community.

Covering an application of Texaco No. 55 surfacing material to provide the road with a tough waterproof mat

Progressive Low-Cost Road Construction

By A. J. Moynihan,
Field Engineer, The Texas Co.

Thousands of miles of existing stone and gravel highways provide an excellent base for progressive or stage road construction. In this article are outlined some of the methods available for low-cost improvement of such roads to meet modern traffic conditions.

BEFORE undertaking the work, it is necessary that a careful survey be made of the base, with reference to drainage, supporting strength, surface conditions and cross-section. New metal which may have to be added should be placed sufficiently in advance so that it becomes thoroughly compacted and an integral part of the roadway. Unsatisfactory drainage condition should be corrected; the surface brought to proper cross-section and, where necessary, alinement should be corrected. The surface is then ready for necessary subsequent treatments, which may be a mat, a carpet coat, or a road-mix or pre-mix surfacing.

If the traffic is light, a simple treatment with an asphaltic dust palliative may give complete satisfaction. When this is applied annually, a mat coat may be built up over a period of time that will provide a smooth, dustless, waterproof surface, which will serve light traffic for a number of years.

Surface Treatments

When traffic increases and it is desired to add to the stability and traffic capacity of the road, a treatment of cutback asphalt may subsequently be used with a fairly heavy covering of fine aggregate. This treatment may be given the first year, several weeks or months after the application of the dust palliative treatment, or it may be deferred until increasing traffic requirements necessitate a higher type of surface. The small expenditure involved—usually around 6 or 8 cents a square yard for the lighter surface treatments—greatly increases the serviceability of the roadway and its capacity to carry traffic. Construction methods are simple, and equipment necessary for satisfactory work is not costly.

Mixed-in-Place Surfaces

While it is possible to construct surface treatments of varying thicknesses, such surfaces when laid to a depth of more than one inch are usually termed "mixed-in-place" or "retread" surfaces. This type of treatment, while low in first cost, is capable of carrying a heavy concentration of traffic, and when properly constructed, gives a riding surface of exceptional smoothness. Generally, the thickness and the type of the surface are determined by traffic requirements. By harrowing, blading, and spreading with graders and maintainers, and rolling a very stable and traffic-resistant surface is obtained, which has the advantage of low cost.

Pre-Mixed Surfaces

The pre-mix asphaltic types are prepared at a central plant and hauled to the roadway. (Truck-mix units are being tried out on this work, also.) Spreader boxes, attached to the trucks, are often used for primary spreading, and by proper handling the material can be spread very evenly on the road. A maintainer is generally used for final shaping before rolling. Emulsified asphalt, cutback asphalt, asphalt with a solvent added at the time of mixing, or other bituminous products, can be used satisfactorily in constructing this type of surface.

A more uniform coating of aggregate, and the elimination of the harrowing, mixing and application of bituminous materials, such as are necessary in the road-mixed types, are among the advantages claimed for this method. The traffic capacity is high. When properly finished (sometimes a mechanical finisher is used) the riding qualities are excellent. In 1932, California laid several stretches of such surface on which the smoothness measurements were under 11 inches per mile. The cost of this type is, under most conditions, slightly higher than that of the road mix, but much depends on local conditions.

Seal Coats

In both road-mix and pre-mix construction, a seal coat is applied and then covered with aggregate. These types of surface are of the so-called non-skid character; the non-skid feature is renewed by added applications of bituminous material and aggregate.

With proper supervision, and at a minimum cost, such stone and gravel highways can be preserved and made serviceable, satisfactory and safe under increasing traffic by means of progressive construction methods. Construction costs are kept to a minimum and expenditures are necessary only as dictated by, and in accordance with, the increasing traffic requirements. The total cost, though small, is spread over a number of years, thus reducing initial expenditures.

(*Continued on page 12*)

Some Causes and Effects of Stream Pollution

By J. K. Hoskins

Sanitary Engineer, U. S. Public Health Service in charge of Stream Pollution Investigations Station, Cincinnati.

IN general, polluting substances discharged to streams may be classified as: (1) Toxic or harmful stable chemicals such as poisons, acids, alkalis, oils, dyes and similar substances which exert a direct detrimental effect upon animal and plant life; (2) inert substances such as clay, sawdust, wood pulp and carbon, which, while not in themselves injurious, yet by their presence, create objectionable conditions and interfere with the normal uses of the waters into which they are placed; and (3) organic matter, including sewage and numerous industrial wastes which decompose in the receiving stream, reduce the dissolved oxygen content and frequently contain pathogenic organisms.

The first class are most varied in composition and frequently very difficult to remove if they reach streams, wherefore it is generally advisable to remove them before they are discharged into streams. The unfavorable effects generally manifested are classified by Donaldson as (a) disagreeable odors and tastes; (b) unsightly appearance or interference with proper functioning of treatment processes; and (c) damage to water works structures, and rendering the water less fit for domestic or industrial use on account of hardness or other chemical properties, and possibly detriment to health.

Of inert substances, the most common and abundant is soil washed in by surface run-off.

Of organic matters, the most varied and extensive are those contributed by sewage and industrial wastes; the former frequently carrying pathogenic bacteria.

Elimination or diminishing of the harmful effects of these polluting matters is effected by natural self-purification and by artificial measures undertaken by man.

Self-Purification

Harmful effects of chemicals are generally greatly reduced or eliminated by dilution, and frequently by chemical reactions between each other or with mineral matter carried in suspension or solution in the stream. Inert substances generally settle out.

The natural purification of organic polluting material in streams is dependent upon the biochemical action of bacteria and plankton present in the water—aerobic if they proceed in the presence of oxygen, anearobic if in its absence. Aerobic decomposition processes are comparatively rapid, direct and inoffensive and result in the formation of stable mineral compounds. Anaerobic decomposition results in some stable mineral forms and in addition other mineral products of objectionable qualities such as methane and hydrogen sulphide which contain no oxygen.

A wide variety of bacteria in water use the organic matter for food, breaking down the complex compounds in the process and converting them into stable forms when an excess of dissolved oxygen is present. The course of these fermentative changes occurring in the organic matter proceeds in two distinct and separate stages. The first stage produces chiefly carbon dioxide and water, together with small amounts of organic products or humus. During the second stage of fermentation the ammonia and humus are oxidized to nitrates and carbonates. Anaerobic decomposition takes place only during the first stage and then only when the dissolved oxygen has been exhausted; it never recurs in the second step of the fermentation process. The motivating power in both these stages is the bacteria.

Extended observations indicate that these bacteria are most active, if not entirely so, during the time of their multiplication. When no agencies are present to interfere with their normal reproduction, multiplication of bacterial numbers will proceed to a definite maximum or ceiling, depending upon the concentration of available food material—that is, organic pollution. During this multiplication stage available dissolved oxygen is used up, but when the upper limit of bacterial concentration is reached, further activity practically ceases and little further oxygen is required. If now some natural enemy is introduced that reduces the bacterial concentration, such as bacteria-eating plankton, further multiplication is stimulated to maintain the upper limiting number and oxidation of the organic matter again proceeds to completion. It would appear, then, that at least one of the functions of the animal plankton in polluted water is to control the biological balance and stimulate the development of bacterial cells which in turn is necessary for the natural course of oxidation of organic matter. These plankton, therefore, have just as essential a role in the natural purification process as have the bacteria or the dissolved oxygen.

These bacteria and plankton are normally present in polluted water, but the sufficient supply of dissolved oxygen required for their oxidation work is the factor that usually limits the speed of nautral purification in polluted streams. When this oxygen supply is deficient, objectionable putrefactive conditions result. This reserve dissolved oxygen supply is never large, because the capacity of water for the solution of oxygen ranges from approximately 14 milligrams per liter at just above freezing to about 7.6 milligrams per liter at 30°C.; or, in other terms, from about 0.81 grains to 0.44 grains of oxygen per gallon of water. Unless this dissolved oxygen supply is continuously replenished, therefore, the biochemical oxidation is retarded. Nature provides this replenishment under well defined laws, through the process of reaeration. If the pollution is so intense that the rate of withdrawal of oxygen is continuously greater than the maximum rate of reaeration can supply, a condition of complete deoxygenation will result and anaerobic fermentation will ensue, until the reaeration rate can exceed the withdrawal rate.

Another phase of the natural purification phenomenon is the rate of disappearance of bacteria in polluted streams, including both the harmless forms and pathogens. Extended observation of bacterial decrease below sources of organic pollution in such larger streams as the Ohio, Illinois and upper Mississippi rivers show definitely that these rates are usually orderly, consistent

and (within limits) quite uniform under similar conditions. They are higher in summer than in winter, are apparently modified by the original concentration of bacterial pollution, and are disturbed by sudden changes in conditions of flow such as heavy run-off from rains. Further experimental data indicate that the rates of decrease are much more rapid in smaller trickling streams than in large slow-moving rivers.

Artificial Measures for Improving Stream Sanitation

Natural purification of streams may be encouraged in a number of ways. Means may be provided for the precipitation of suspended material through the storage facilities of reservoirs, and for hastening reaeration by extensive surface exposure (as is now being practiced in the Ruhr river in Germany), by agitation or turbulence of the flowing water, by adding oxygen-bearing chemicals to furnish an additional source of available oxygen; or biochemical oxidation may be temporarily delayed by disinfecting chemicals such as chlorine.

The beneficial effect of storage in aiding natural purification is well exemplified in the Ohio river, now completely canalized during low-water flows. The pools thus formed greatly extend the time of flow between points of major pollution such as Cincinnati and Louisville and during pool stages little observable effect of the pollution contributed by Cincinnati's population of over 600,000 can be detected at Louisville, 140 miles below, although during periods of high water, when the channel is unobstructed by navigation dams, the pollution contributed by Cincinnati is readily determined in the river above Louisville.

Interception from the river of polluting matters carried by sewage is effected to varying degrees by sewage treatment; the degree necessary depending upon the available oxygen of the stream and the extent to which polluting matters, even though oxidized, must be eliminated.

A most encouraging development in the control of stream pollution in recent years has been the cooperation of industry with government in earnest endeavors to find practical solutions for industrial waste disposal problems. The replacement of mutual suspicion of motive by mutual understanding of purpose on the part of both industry and administrative authority has resulted in real advance and practical accomplishments.

The above is greatly condensed from a paper before the National Safety Congress.

Progressive Low-Cost Road Construction

(*Continued from page 10*)

Details of such methods of progressive road construction will be found in the specifications of most of the State Highway Departments, by whom these methods are now being used. Many of the more progressive counties are also employing these ideas. Costs, which vary with the prices of aggregate and bituminous materials suitable for the type of construction adopted, are small, especially in view of the results obtained. Surfaces are secured which, when tested with a 10-foot straight-edge parallel to the center line, will not show a variation greater than ¼ inch. Salvage value of almost 100% is possible, by proper maintenance and by adding to these surfaces from time to time in accordance with increasing traffic.

Preparing a Public Works Report

An annual report "intended to put the important facts about public works before the citizens in a simple, forceful, attention-compelling way," "to tell citizens the story of the department's accomplishments and to arouse their interest in what many dismiss as dry and technical matters" should be published by all public works officials, in the opinion of the Committee on Uniform Street and Sanitation Records. In order to assist officials in preparing such reports it has issued a pamphlet giving suggestions, both general and specific, which every official should find useful.

Among the general suggestions, the first is promptness. "If the report can not be published within two months after the close of the year, it should probably not be published at all. The effectiveness of the report will be doubled if published within one month."

For size, 6¾" by 9¾" is recommended. A good grade of paper should be used, and no type smaller than 10 pt.; and the cover and general make-up should be attractive.

Expensive embossing, maps, lengthy tabulations, fancy paper and other frills should be avoided.

Choose a printer with some experience in preparing publicity material and get his advice on selection of paper and type, arrangement, etc.; he can give emphasis and variety to the matter by use of different sizes, styles and faces of type.

The text should be clear and concise, giving a complete picture, with each activity occupying space in proportion to its relative importance.

Rigorously eliminate all but the absolutely essential. Cut out all materials which do not have a significant bearing upon the city's services; use condensed and summarized tables, graphs and charts.

Wherever possible, comparative data, covering two or more years, should be reported.

The names of the chief officials of the city as well as of the public works department may be listed, but in no case should pictures of them be included.

A short table of contents and list of tables and charts.

A sufficient number of copies should be printed to supply all officers of civic groups, taxpayers' organizations, governmental officials, newspapers, libraries, and prominent business and social leaders, and notice given that others can obtain copies by applying at the city hall or libraries; and exchange of reports should be carried on with other cities of like size and conditions.

The pamphlet then enlarges on each of these items, offering forms for tabulation of facts, expenditures and receipts, etc., and suggestions of diagrams, graphs, photographs and other illustrations. Copies of it may be obtained from the Committee on Uniform Street and Sanitation Records, 923 East 60th Street, Chicago.

Substantial Performance of Grading Contract Authorizing Recovery

In cases of working contracts, if the contractor substantially complies with the contract, even though he has failed in some minor particulars, he is entitled to recover the contract price less what will be a fair allowance to the owner to make good the defects in the performance of the contract. Reese v. Kline Bldg. & Const. Co., New Jersey Supreme Court, 149 Atl. 826, an action arising out of a written contract for excavation and grading.

Surfacing a Village Street With Mixed-in-Place, Using Tar

Left, Superintendent John Lawrence. At right, a section of the street and the finished surface.

THE old surface of Champlin Avenue, Liberty, N. Y., was a worn-out water-bound macadam, very rough in spots. In fact, in some places none of the macadam was left, but, due to several applications of road oil, a thin mat had been built up. Champlin avenue is not a heavy-traffic street, but in the summer carries quite a large number of vehicles per day.

For resurfacing this year, a tar mixed-in-place surface was chosen. The old surface was scarified, bladed to the proper cross-section, and rolled, to form the base of the new surface. A tar priming coat was applied, and then a layer of broken stone was placed and spread. This averaged 4 inches in depth, but in order to bring the grade to a smooth surface, some extra stone had to be placed, giving a depth of 6 inches over some areas. This course was bladed to a smooth surface and given an application of tar. It was then mixed with a grader and dragged and then given another light application of tar.

Following another mixing and grading, it was rolled. This second application of tar was given because the stone was not very clean or sharp. The voids were then filled with small stone, spread and brushed in by hand, and rolled to key the surface. A seal coat was then applied.

The stone for the base course was obtained from the contact beds of the village's abandoned sewage treatment plant, which was replaced with a modern plant two years ago. The stone was loaded into trucks from the contact beds by power shovel and hauled to the street, a distance of two miles. Slightly over 500 cubic yards of this stone were used, the total cost for it delivered on the street being $222.25. The No. 1 stone used for the surface layer cost $261 for the 100 tons required, delivered at the job. Two gallons of Tarmac were applied per square yard. The total cost was 41.3 cents per square yard.

The street is 2200 feet in length; 1900 feet is surfaced for a width of 18 feet, and 300 feet to width of 24 feet. Only village equipment — a Cletrac tractor, a grader, roller and trucks—was used on the work, except that the power shovel for loading the stone at the contact beds and some of the trucks were hired. The surface smoothness is very satisfactory and the riding qualities excellent.

The itemized costs of the work are as follows:

Grading road bed, 135 hours of labor at 40 cents an hour	$ 54.00
Roller, with scarifier and preparing old road bed, 18 hours at $3.12½	56.25
Loading stone at sewage plant, power shovel, 16 hours at $6.25	100.00
Hauling stone from sewage plant to road (about 2 miles)	122.25
Mixing and grading stone on road bed	26.40
100 tons No. 1 stone at plant	100.00
Freight on No. 1 stone	116.00
Carting stone from station to road, 36 truck hours at $1.25	45.00
Spreading No. 1 stone and sweeping in voids, 121 hours at 40c	48.40
Rolling top stone, 16 hours roller and operator at $3.12½	50.00
9,000 gallons Tarmac P-6, delivered and applied at 14c per gallon	1,260.00
Total cost	$1,978.30
Total yardage	4,600
Cost per square yard	41.3 cents

The work was done under the direction of John Lawrence, superintendent of public works of the village, using village forces and village equipment, except as noted above.

Driving and Its Hazards

It is estimated by the National Safety Council that a motorist's chances of being killed are approximately one in 1,000. Figures based on a study of 100,000 accidents over a period of 15 years by the Council indicate:

1. If you cut out of the line of traffic your chances of having an accident are multiplied by 50.
2. If you drive at reckless speed your chances of having an accident are multiplied by 25.
3. If you pass another car on a curve without clear and unobstructed visibility ahead your chances of having an accident are multiplied by 21.
4. If you pass another car going uphill while nearing the top, your chances of having an accident are multiplied by 10.
5. If you fail to signal your movements when a car is behind, your chances of having an accident are multiplied by 5.

Law Suit Prevention

By W. W. Reeder

Drawing by M. C. H.

Engineers are accustomed to dealing with facts and they get many a shock by having a lay jury bring in a verdict against them after a smart lawyer has twisted their facts far beyond any imaginable torsional limit. This article tells how to provide an adequate factor of safety against such potentialities.

MUNICIPAL Treasuries are often looked upon as fair game by every hunter after easy money, and there are neither closed seasons nor game laws to give protection. Every piece of curbing that has been broken during the last five years will have been caused by that highway resurfacing job you did last week. Sewer construction will bring a surprising number of claims for settled foundations and cracked plaster; and any blasting on the job seems to shatter everything from crockery to nervous systems over a wide radius. Microscopic holes in the highway can lead to claims for damaged tires and broken springs. And it is indeed remarkable the number of sprained ankles and the amount of ruined clothing which can result from the raised joint in a cement sidewalk.

One method of presenting facts in a way that is hard to combat is by photographs. The writer recently had a large storm sewer to install along the gable ends of a number of houses. The edge of the excavation was only three feet from the foundation walls, and the bottom of the trench was twelve to fourteen feet lower than the cellar floors. Most of the stone foundations showed numerous settlement cracks prior to the construction, some of which extended up through the superstructure almost to the roof.

Photographs to the Rescue

Before ground was broken, a series of photographs, 8 in. by 10 in. were taken by a commercial photographer. The location, date, hour, and names of two witnesses were so marked upon the plate as to show on the finished print. On this particular project twenty-two photographs were made at a cost of two dollars each. The pictures were taken most ostentatiously. We wanted the property owners to know that a complete record was being prepared of the condition of their buildings before work started. The small expenditure was well justified. Not one claim was made for damages, which can be attributed to the fact that property owners knew a strong defense had been prepared.

Such photographs should be taken by a disinterested party, and having dates and the names of witnesses on the negative make the picture more valuable as evidence. Any building condemned by a municipality should be photographed before demolition, to show the defects which have resulted in the condemnation.

On all of our construction projects an inspector makes a complete examination of the location of the work and files a written report, with sketches, of all defective paving, cement work, and adjacent structures. These reports have proven invaluable. Daily reports are also prepared during the progress of construction, giving the stations, and extent of work engaged in on that date. The time, location, and quantity of explosives used for each blast, are also noted. These preliminary and daily reports may be called upon to form the basis of a strong defense in some damage claim, and should be carefully prepared, and as carefully filed.

Claims From Defective Sidewalks

Our Township has over two hundred miles of cement sidewalks. In spite of the fact that property owners are responsible for the maintenance of these walks, we have had, in the past, numerous claims from pedestrians for damages resulting from defective sidewalks. In 1932 an inspector was assigned to report upon the location of all raised joints, damaged curbs, and broken sidewalks. A form letter was prepared, and after the necessary details had been added, sent to the property owners. A specimen reads as follows:

> Dear Sir:
>
> We wish to call your attention to the condition of the *sidewalk* abutting your property, which *has two raised joints and one broken slab.*
>
> Should any accident occur thru your neglect to repair the same, you will be held responsible for all claims for damage.
>
> The Township has no official cement contractor, nor do we recommend any certain contractor.
>
> Will you please give this notice your prompt attention.
>
> Very truly yours,
>
> .....
>
> Dept. of Public Works.

Of course the property owners could be compelled to make the repairs requested but this form letter was sent as a friendly warning, and was generally accepted as such. Out of 758 notices sent during the year over forty per cent resulted in the repairs being made. The campaign received some newspaper publicity, and the number of damage claims dropped much more than the percentage of repairs made would have indicated.

Highway Paving Defects

Claims for damages arising from holes in highway paving are a reflection on the efficiency of the maintenance forces. Our hundred and thirty-four miles of highways are constantly being patrolled in search of defects. In addition to our highway inspection the police must report any damaged paving which might become dangerous. By constant attention to such repairs damage claims from this source can be reduced to a minimum.

Just as it never seems to rain when you take an umbrella with you in the morning, damage claims are few and far between when everyone knows you can defend with uncontestable facts. It is far cheaper to prepare a defense for twenty claims which never reach court than to have one case come to trial. Juries are unaccountably generous with anyone bringing a claim against a municipality. Sound written and photographic records win many cases which never reach the court calender.

THE EDITOR'S PAGE

The National Recovery Program

PUBLIC WORKS congratulates the National Recovery Administration on the results of its work to date. The courage, vision and energy that have gone into this work augur very well for its final and complete success.

Furthermore, PUBLIC WORKS takes pleasure in announcing the continuation of its policy for several years past, covering employment, hours of labor and wages, which policy is fully in accord with the blanket code laid down by the NRA, and with other codes affecting our industry.

What Will The Harvest Be?

A question of much interest, in connection with the proposed plan for recovery through public works construction, has been: For what purposes will the money be used? It is not only interesting; it is important. Money should not be wasted, no matter how cheaply it comes. Every dollar, especially in these times, ought to do its full duty.

Through the cooperation of more than a thousand municipalities, the Editors of PUBLIC WORKS have learned something of the purposes for which this money, if and when received, will be spent. Water supply and purification systems and sewerage and sewage treatment projects head the list by a large margin. Extensions to water and sewer systems and swimming pools, are also included quite generously in the sanitary engineering projects.

Municipal lighting plants, long popular in the middle west, are mentioned by a good many cities, towns and villages. Highway improvements, bridges, city halls, and other structures are also contemplated.

Necessity for Public Works Construction

One can legitimately ask the questions, "Where is the money going to come from to carry out the NRA program?" "Where will the employer get the extra money to pay higher wages for shorter hours of labor or even for the same hours?"

No business can run at a loss indefinitely. For the vast majority of concerns, whose surpluses have been sorely depleted or wiped out after three years of greatly reduced operations, the money can only come through increased sales. And it is obvious that the general public, living on reduced income or struggling on no income, cannot buy any more before it gets higher wages in the one case or some wages in the other case. Thus we perceive the vicious circle into which business fell.

It is apparently the intention of the administration, by promoting the construction of needed, beneficial, public works, to put $3,300,000,000.00 of new purchasing power in the hands of the consuming public so that it can buy more. Each time that money passes from one hand to another, sales will increase by that much. The heart of the National Industrial Recovery Act lies in that public works section. Through it the government has the means of breaking the vicious circle and pumping fresh blood into the weakened body of industry.

It is obvious that without that provision NIRA would be merely another futile plan for industry to raise itself by its own bootstraps. In the end of course the money borrowed for these projects must be repaid, but that can be done out of the larger government income resulting from increased business and the repeal of prohibition.

The paramount problem today is to get the public works program under way at the earliest possible moment. Last month we urged that everyone add his bit in any effort to prevent scaling down of the expenditures for public works. This month, we urge that all join to expedite getting the work under way. The construction season remaining for 1933 is short.

The work should be started now, so that it will be really under way before another hard winter is on us, with its inevitable calls for relief expenditures which do no one any lasting good; perhaps, least of all, those who receive it.

In undertaking such a vast construction program quickly some mistakes are to be expected. It is just a question of weighing their cost against the cost to the nation if NRA bogs down, and when that is done there can be no choice.

The American Road Builders' Association

The highway industry should not forget the past very valuable services of the ARBA, nor should it fail to support it at this time. With the Bureau of Public Roads likely to be completely busied with many other activities for the next few years, there is more than ever a need for a strong influence in the industry. There is no space here to enumerate the many branches of road-building in which progress is needed. There is no time to build up any other organization that is capable of doing even a small portion of the good that the ARBA can do. What is needed is moral, technical and financial support of an organization that has proved itself in the past, and has the capacity for most valuable work in the future.

WATER PURIFICATION STUDIES

The Bacterial Efficiency of the Excess-Lime Method of Water Purification

By H. W. Streeter
Sanitary Engineer, U. S. Public Health Service

THE treatment of water with lime has been practiced for many years in water softening, for the purpose of removing temporary hardness, and also in connection with ordinary water purification, for bringing about coagulation with sulphate of iron and for preventing corrosive properties in effluents due to the presence of excessive amounts of carbonic acid.

The chemical effects of lime treatment are usually very simple, consisting of reactions with the free carbonic acid and soluble bicarbonates of calcium and magnesium, with formation and precipitation of the more insoluble normal carbonates of these elements. If the amount of lime added to water is more than sufficient to combine with all of the free and half-bound carbonic acid (i. e. bicarbonate), an excess of free hydroxide, or causticity, will remain after treatment. If only enough lime is added to leave normal carbonate, but no hydroxide, the final reaction is basic, rather than caustic. The term, "excess-lime" treatment, refers more strictly to that which produces causticity in the treated water, but sometimes is applied to the use of lime in subcaustic doses, as well, and will be so understood in this paper.

Some years ago, Sir Alexander Houston, in connection with his studies of the quality of the London water supply, first proposed excess-lime treatment as a method of disinfecting water, reporting that the addition of one part of quicklime to 5,000 parts of water (roughly, 12 grains per gallon) would kill B. coli in 5 to 24 hours.* His conclusions in this respect were confirmed by Hoover and Scott in this country† and, later, by experience in Ohio.** More recently, Bahlman has noted at the Cincinnati filtration plant that the addition of lime in subcaustic doses results in a measurable bactericidal effect on the treated water.§

In view of the increasing importance of the excess-lime method in modern water purification practice, it was decided to include a study of its bacterial efficiency in the series of experimental investigations made by the U. S. Public Health Service at its Cincinnati experimental plant during the five years, 1924-29. It was desired more particularly to compare this process, as an auxiliary method of water disinfection, with raw water prechlorination, which had been tested during the previous year and the results of which have been published elsewhere.††

The experiments in excess-lime treatment were carried out during a period of about nine months, extending from early in November, 1928, to early in August, 1929. In order to facilitate a direct comparison of the results obtained from day to day with and without the excess-lime treatment, the plant was separated into two parallel sections, A and B, the flow of raw water being divided equally between them. Lime was added only to the water passing through section A, the treatment being otherwise the same in both sections and consisting of the usual coagulation, sedimentation, rapid sand filtration and postchlorination.

Before beginning the experiments, it was decided that more effective and economical operation of the excess-lime treatment could be obtained by adding a supplementary mechanical agitation unit to section A of the plant, just ahead of the point of entry of water into the coagulation basin. By this means it was possible to secure a thorough and relatively slow mixing of the lime with the lime-treated water for a period approximating 40 minutes, before passing it into the basin. This mechanical agitator was very simple and economical in design, consisting merely of a circular wooden tank of 8 ft. diameter and 6½ ft. depth, equipped with a 5 H. P. motor-driven paddle of the gate type revolving around a vertical shaft. A speed variator of the Reeves type, inserted between the motor and the paddle mechanism, permitted variations in the speed of agitation ranging from ½ to 6 revolutions per minute. The cost of the entire equipment, including pipe connections, was about $850.

The first three months of the experiments, extending up to the early part of February, 1929, constituted a trial period, in which alum was used as the coagulant and the amounts of lime added were sufficient to cause various degrees of basicity, but not enough to leave any measurable causticity. The results obtained during this period were quite erratic and showed little consistent advantage due to the lime treatment. Beginning with February 11th, sulphate of iron was substituted for alum as the coagulant for the lime-treated water and the dosage of lime was increased to an extent such as to produce causticity. From this time up to early in June,

*Eighth Research Report, Metropolitan Water Board, London, England.
†Engineering Record, Sept. 6, 1913, p. 257.
**Tenth Annual Report, Ohio Conference on Water Purification, p. 56.
§Ohio Conference on Water Purification: Eighth Annual Report, p. 56; Tenth Annual Report, p. 59.

††U. S. Public Health Service, Public Health Reports, Vol. 45, No. 51, Dec. 19, 1930, p. 3105 (Reprint No. 1434); also Jour. Am. Water Works Assoc., December, 1930.

the degree of causticity was gradually increased, until it reached approximately 70 parts per million. During the last two months of the experiments, up to their completion in August, the causticity was gradually diminished to less than 10 parts.

treatment after coagulation and sedimentation. In this water the numbers of bacteria observed in the lime-treated water were consistently lower throughout the entire range of raw water numbers than in the water not thus treated. In the unchlorinated filter effluent, desig-

TABLE NO. 1

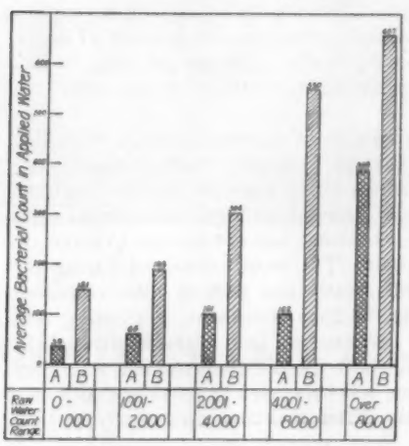
Comparative Average Numbers of Bacteria Observed Coincidently in Same Water With and Without Excess-Lime Treatment.

(Period, November 1, 1928,—June 7, 1929).
A = With excess-lime treatment. B = Without excess-lime treatment.

Raw waer range	Average Bacterial Numbers Applied			Filtered		Chlorinated		Turbidity Applied			pH Applied		
	Raw	A	B	A	B	A	B	Raw	A	B	Raw	A	B
					1. Bacterial Count per c.c., 24 hrs., 37°C.								
0-1000	803	35	132	1.0	1.5	0.29	0.14	153	15	16	7.3	10.1	6.6
1001-2000	1400	43	135	.8	.3	.22	.08	254	16	18	7.3	10.3	6.8
2001-4000	2780	90	190	1.5	5.0	.59	.38	287	16	17	7.4	10.1	6.7
4001-8000	5250	79	553	3.7	43.	.96	.25	218	17	18	7.4	10.4	6.8
Over 8000	8290	120	900	5.4	57.	2.0	12.	272	10	12	7.4	10.5	6.8
					2. B. coli Index per 100 c.c.								
0- 5000	2780	392	1340	2.9	8.7	.41	.15	243	15	18	7.3	10.2	6.8
5001-10000	8020	760	1560	47.	10.2	1.6	.42	202	20	21	7.3	10.2	6.7
20001-40000	37900	1040	3480	13.5	63.	8.9	2.1	254	18	21	7.4	10.2	6.7
Over 40000	70200	1060	7730	142.	105.	55.	.68	324	22	29	7.3	10.3	6.7

In order to show an average picture of the results obtained throughout practically the entire course of the experiments, Table No. 1 has been prepared, from the data covering the period of November 1, 1928, to June 7, 1929. In this table the daily average results have been grouped and averaged according to the numbers of raw water bacteria falling within various ranges. The figures given for raw water and effluents are in each case averages for the days on which the raw water bacteria fell within the range indicated. The first section of the table is based on 24-hour bacterial plate counts on standard agar at 37° C., and the second on confirmed B. coli index results. In both sections the effluent figures given under the columns headed "A" are for the lime-treated water passing through section A and those under "B" for the same water unlimed and passing through section B. In the right-hand portion of the table are given the corresponding average turbidities and pH values as observed in the "raw" and "applied" waters (the latter being the usual term for water applied to the filters after coagulation and sedimentation).

On referring to Table No. 1, the advantage of excess-lime treatment is most clearly shown in the comparative bacterial averages observed in the "applied" water, which represents the direct product of the lime



Comparative bacterial counts observed in applied water, with and without excess-lime treatment, for various ranges of raw water bacteria. (Plotted from data given in Table 2)

nated as "filtered," the advantage of lime treatment is likewise manifest, though not so consistently as in the applied water. In the final "chlorinated" effluent, however, the advantage appears to have been very largely reversed in favor of the unlimed water, which was shown quite consistently as being of slightly better quality than the corresponding effluent from the lime treatment.

In order to show more clearly the effect of excess-lime treatment when carried to a point of consistently high pH value, Table No. 2 has been prepared from the same bacterial data as have been grouped and averaged in the first section of Table No. 1, except that only daily results have been included in which the residual pH value after lime treatment was in excess of 10. In this table the margin of advantage in favor of the excess-lime treatment is shown to have been greater in the "applied" and "filtered" waters, but again somewhat reversed in the final "chlorinated" water, though not quite as consistently so as in Table No. 1. In Figure 1, the "applied" water figures given in Table No. 2 have been shown graphically, for more ready comparison.

In order to study the possibility of a relation existing between the intensity of excess-lime treatment and its bacterial efficiency, the bacteriological data obtained from the experiments were regrouped and averaged according to the mean degrees of causticity remaining in the "applied" water on various days. The results of this analysis, which are given in Table No. 3, show a consistently well-marked increase in the bacterial efficiency of the process coincidently with greater degrees of causticity. In Figure 2 the comparative percentages of raw water bacteria remaining in the "applied" and "filtered" waters, with and without excess-lime treatment, have been illustrated graphically from the figures given in Table No. 3.

In this table, it will be noted that both the numbers of bacteria and their equivalent percentages of the raw water bacteria are shown to have diminished progressively with increased amounts of causticity, not only in the applied water but in the filtered and chlorinated waters as well. It thus appears that when excess-lime treatment was carried definitely into the ranges of causticity, the bacterial efficiency of the process as a whole and also of its component stages was definitely related to the intensity of treatment.

TABLE NO. 2

Comparative Average Numbers of Bacteria Observed Coincidently in Same Water With and Without Excess-Lime Treatment.

(Includes only results obtained when pH of lime-treated water was 10.0 or greater).
A = excess-lime treatment. B = ordinary treatment, with alum as coagulant.
Bacterial count per c.c., 34 hrs., 37°C.

Raw water range	Average Bacterial Numbers							Turbidity Applied			pH Applied		
	Applied			Filtered		Chlorinated							
	Raw	A	B	A	B	A	B	Raw	A	B	Raw	A	B
0-1000	810	39	151	0.74	4.2	0.29	1.06	124	18	21	7.3	10.2	6.8
1001-2000	1390	65	193	2.1	4.2	.72	.59	215	18	21	7.3	10.3	6.7
2001-4000	2940	101	304	1.0	4.8	.13	.33	278	18	18	7.5	10.2	6.8
4001-8000	5510	102	550	3.6	31.	.86	.74	275	20	23	7.4	10.3	6.8
Over 8000	10500	388	657	138.	106.	24.	42.	478	26	33	7.3	10.2	6.8

TABLE NO. 3

Comparative Efficiencies of Bacterial Removal With Varying Degrees of Causticity in the Lime-Treated Water, as Applied to the Filters.

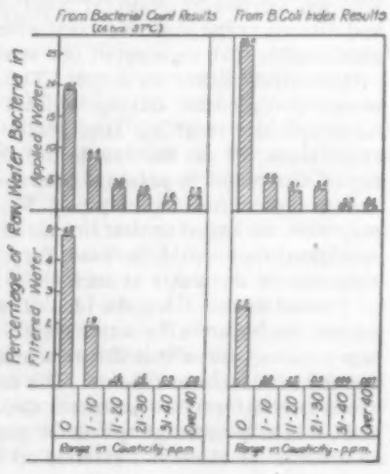
Causticity range p.p.m.	Average Bacterial Count per c.c., 24 hrs., 37°C.				Per cent of Raw Water Count			Average causticity p.p.m.
	Raw	Applied	Filtered	Chlorinated	Applied	Filtered	Chlorinated	
0	12200	2340	588.	286.	19.2	4.8	2.3	0
1-10	6920	579	132.	33.	8.4	1.9	.48	7
11-20	4530	174	7.4	2.1	3.8	.16	.05	16
21-30	4460	114	6.1	1.3	2.6	.14	.03	25
31-40	3250	51	.92	.16	1.6	.03	.005	35
Over40	2250	53	.80	.10	2.3	.03	.004	53
	Average B. coli Index per 100 c.c.							
0	52600	13900	1320.	301.	26.4	2.5	.57	0
1-10	30800	1420	91.	7.8	4.6	.30	.02	7
11-20	21500	667	47.	3.2	3.1	.22	.01	16
21-30	20700	705	6.8	.50	3.4	.03	.002	25
31-40	20900	195	1.3	.08	.93	.006	.0004	35
Over 40	18700	158	1.3	.07	.84	.007	.0004	53

In connection with Table No. 3, it is of interest to note that with a causticity ranging above 20 p.p.m., a final chlorinated effluent having a B. coli index well below the upper limit fixed by the U. S. Treasury Department standard (i. e., 1.0 per 100 c.c.) was produced from raw water having a B. coli index approximating 20,000 per 100 c.c. With a causticity ranging above 30 p.p.m., the corresponding quality of the unchlorinated filter effluent was but slightly poorer than the requirement of the same standard. From this viewpoint, the efficiency of excess-lime treatment, when intensified to a relatively high degree, may be compared very favorably with that of raw water prechlorination in combination with ordinary postchlorination, which previous experiments by the Public Health Service have shown can produce a final effluent conforming to the Treasury Department standard from raw water having an average B. coli index ranging as high as 20,000 per 100 c.c.

Aside from the definite indication that an excess of lime sufficient to result in causticity exerts a well-marked bactericidal effect in lime-treated water, perhaps the most interesting observation made in these experiments was that the bacterial efficiency of postchlorination may be measurably diminished by excess-lime treatment, under average conditions such as prevailed during these experiments. As a period of only 20 minutes, or thereabouts, ordinarily elapsed between the time of chlorination and that of collecting the chlorinated water samples, it seems possible that this result may have been due to a lag effect in the bactericidal action of chlorine caused by some change in chemical condition reflected in the increased pH value of the water after excess-lime treatment. If this is a reasonable explanation of the phenomenon observed, it is possible that recarbonation of a lime-treated water, with a consequent lowering of the pH value, would tend to rectify the lag effect observed. As no facilities for recarbonation of the effluent were available in these expriments, it was impracticable to study this phase of the question.

Two other questions, of considerable importance, remained unsolved from these experiments. First is that of the possible effect which recarbonation of an excess-lime treated water might have on the apparent lethal action produced by excess-lime treatment. If such action be immediate and permanent, then subsequent recarbonation would not be expected to modify the result observed. If otherwise, some doubt may remain as to whether or not a partial or complete restoration of chemical equilibrium in a water thus recarbonated would permit a secondary multiplication of the bacteria surviving excess-lime treatment, as has been shown in the first paper of this series may occur under favorable conditions after chlorination, or even a revival of bacterial cells rendered inactive, rather than dead, by such treatment.

(Continued on page 20)



Comparative percentages of raw water bacteria remaining in applied and filtered waters, with various ranges of causticity in the applied water. (Plotted from data given in Table 3)

LEFT: *A pair of filters showing hook-up for double filtration.* RIGHT: *Carbon feeder made from water meter*

Filter Operation in a Small Water Plant

By M. B. Dilmore

Chief Engineer and Superintendent of Filtration, Seneca Falls, N. Y.

WE see many articles on the operation and maintenance of large water plants, but not very much about the smaller ones. As I would like to hear how the other fellow solves some of his problems, I will try to start the ball rolling by telling of some of our own experiences.

Seneca Falls, N. Y., is a village of about seven thousand inhabitants, lying in the Finger Lakes region. The plant, which was bought by the village in 1929 from the Federal Water Company, takes its water supply from Cayuga Lake. Filters of the pressure type having a capacity of 2 m.g.d. are used. In 1930 the services were all metered, cutting the consumption one third.

We have no sedimentation basin, and there were some complaints in cold weather about alum going through the filters in solution and flocking in the mains. The writer, after getting permission from the superintendent, S. W. Pratt, piped the filters so as to give double filtration, and this stopped the flocking in the mains. With the exception of a few fittings, this was accomplished with material salvaged from the old steam plant.

Then we had tastes and odors to contend with. We set up an experimental filter and put three inches of activated carbon in granular form on top of the sand and filtered at the same rate as the large ones with such good results that we covered our secondary filters with carbon three inches in depth. This has been in use twenty-two months, during which time we have had no complaints resulting from tastes or odors. As far as we know, we are the first to use activated carbon on top of filter sand in pressure filters.

When the filters were piped for double filtration, they were arranged so that in case of fire or heavy consumption, they could be used for single filtration to take care of the water at such times.

The writer conceived the idea of making a powdered carbon feeder out of a water meter. The register dial was removed and a ball thrust bearing put in its place for the turn table to ride on. The turn table was made from the platform of a balance scale, six inches in diameter. There is no weight on meter gears except the shaft that turns the table and extends up in the hopper with the agitator arms. The water that is used to run the meter is piped to the funnel where it washes the carbon into a water seal made from a water column of a discarded boiler and from there into the intake of the pump. The machine is inexpensive and very satisfactory.

We have our own laboratory and the plant is run under laboratory control. We are delivering safe, palatable water and are just a little proud of our success.

Bacterial Efficiency of Excess Lime Method

(*Continued from page 19*)

The second question not definitely settled by these experiments is that of the germicidal action of an excess of lime when present in concentrations sufficient to produce basicity, but falling short of causticity. Such data as are available from the present series of experiments have indicated little, if any, consistent bacterial reduction in lime-treated water giving a basic, but not caustic reaction. This result, which is contrary to that experienced by Bahlman at the Cincinnati filtration plant, may be due to the considerably shorter period of contact (6 hours) provided by the sedimentation basin of the experimental plant, as compared with the longer period available at the Cincinnati filtration plant. A systematic experimental study of the influences exerted by time, temperature and degree of basicity on the extent and rate of bacterial decrease in water following lime treatment would throw much light on this question.

When considered solely as a method of water disinfection, excess-lime treatment has been indicated by these experiments as being somewhat more difficult to control and less consistent in its results from day to day than ordinary chlorination. Although this process, when carefully operated, undoubtedly offers a very useful substitute for chlorination under some conditions, its best field of usefulness probably will continue to be in connection with water softening, where the degree of treatment necessary is sufficiently intensive to yield definite and consistent results. In this field, the marked advantages of excess-lime treatment as an aid in the purification of hard waters also polluted bacterially have been clearly shown by the results herein presented.

Assessing for Storm Sewers

By Calvin V. Davis

The methods of determining storm sewer assessments outlined in this article permit them to be determined at the time the designs are made. It would therefore be possible to prepare a tabulation of equitable assessments showing the financial soundness of the project, to be used in securing loans from the Federal government, or in securing approval of the project by the voters of the community.

ASSESSING property for the cost of storm sewers claimed to be beneficial to it gave rise to vigorous opposition by the property owners in Roselle, N. J., and the firm of Hudson and Davis, consulting engineers, of Elizabeth, N. J., was employed by the Borough Council to report upon the subject. Their report brings out some interesting features and problems which may find their counterparts in other municipalities, which may be interested in the solution proposed.

Four systems of storm sewers had been built by Roselle in the period of 1926 to 1929 at a total cost of $165,431, of which $27,086.62 was paid by the county, and the balance by issuing temporary bonds; it being provided that "So much of the cost and expense of such improvements as can be lawfully assessed upon the property especially benefited thereby shall be assessed in the manner and to the extent and in the proportion prescribed by law." But what property is benefited by a storm sewer and what is the value of the benefit?

The engineers stated that "Probably no type of public improvement seems to present more difficulties from the assessment standpoint than does the storm sewer. . . . Practice throughout the country in respect to payments for storm sewer construction is extremely varied, but an ever increasing number of cities are year by year correcting and improving their methods so that a more equitable distribution of individual assessments can be obtained.

"The term *benefit* indicates any advantage which may accrue to a property by reason of an occurrence which augments its accessibility, availability and adaptability, thereby increasing the net earning power of the estate if improved, or its potential utility value if of vacant land."

Legal Decisions Regarding "Benefits"

Study of legal decisions indicated that special benefits may be measured legally in two ways:

"1. The difference in the market values of the property before and immediately after the construction of the improvement.

"2. The fair cost of an improvement that a reasonable owner would make at his own expense in order to obtain the same benefits that would result from the construction of the improvement."

The first method presented practical difficulties. Assessed valuations made after the improvement showed increases varying between 0 and 50% on properties in the same block. The second, however, "affords a direct and scientific solution of the problem," and was used by the engineers in their report; the estimated cost of the "improvement that a reasonable owner would make" being considered the minimum enhancement value due to flood relief and drainage.

Part of the benefit accrues to all property in the drainage area, even if not subject to flooding or contiguous to the original stream. "Benefits such as would warrant the distribution of a substantial part of the cost over the drainage area, however, depend on a complete sewerage service to that area," which would carry water from individual areas to trunk sewers more rapidly than it would flow to them under natural conditions, while the trunk sewers would have sufficient capacities to afford adequate and reasonable drainage to the area as a whole.

Tangible Special Benefits

Properties adjacent to the sewer, or to the natural stream which the sewer replaces, receive special benefits of a tangible nature. These are:

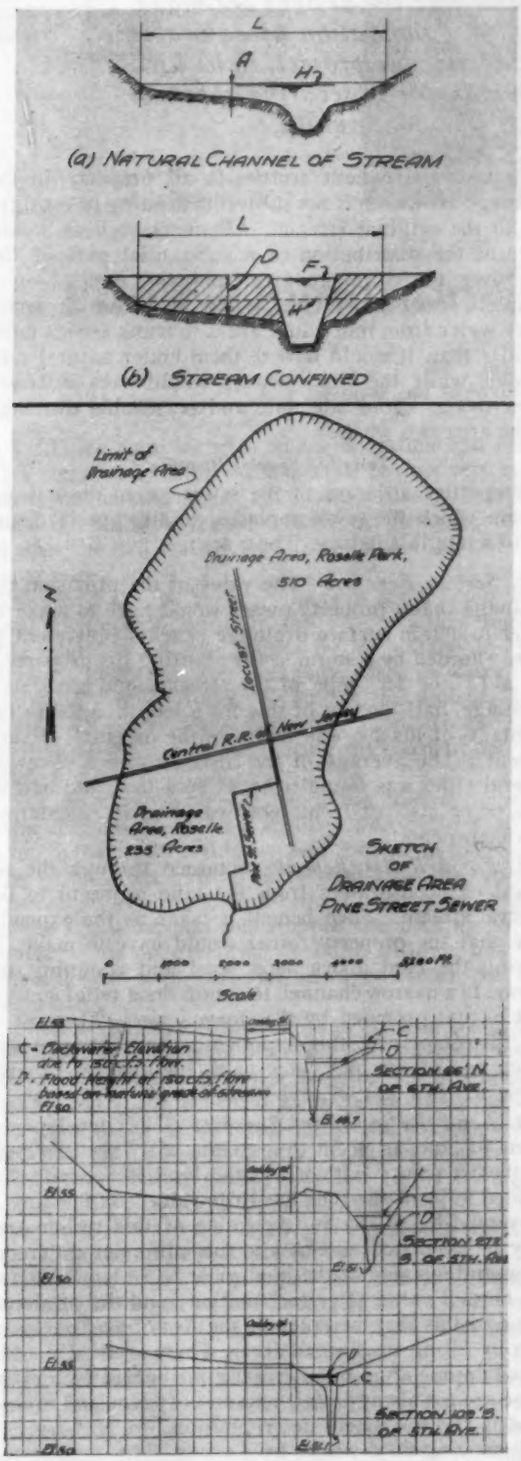
1. *Service Benefits:* "The value of the provision for drainage that a property owner would have to make in order to obtain surface drainage benefits equivalent to those afforded by a storm sewer abutting his property." As a 12″ or 15″ pipe in the street would give such drainage, half the cost of this for a length equal to the frontage of his lot was taken as the measure of such benefit. The average of the costs of such a sewer in several cities was found to be $1.36 a foot, and half of this, or 68 cts. per front foot, was used in calculating service benefits.

2. *Flood Relief Benefits,* obtained through the removal of flood waters from the land adjacent to the natural stream. Such benefit is taken as the expenditure that the property owner would have to make, in raising the land above flood level and confining the stream to a narrow channel, to obtain flood relief equivalent to that provided by the storm sewer. The cost of the fill comprising this hypothetical improvement was taken as 35.9 cts. per cubic yard, the average of costs in eight cities in 1927 and 1928.

3. *Land Reclamation Benefits.* The development value of land adjacent to a stream will vary inversely as the frequency with which the land is flooded; that flooded 90% of the time has little value. If flooding is prevented by filling in, the value of this reclamation may be estimated as equal to the minimum difference between the value of the land prior to reclamation and the normal value after reclamation; and the minimum value of this may be taken as the cost of such reclamation by filling the flooded area. There is usually additional appreciation due to intangible human factors but these are not always a fair measure of value and are not used in the assessment determination.

Removing flood waters by a sewer effects similar reclamation and confers similar benefit. In addition, it restores the stream bed itself to a value equal to that of the land adjacent to it. This value may be taken to

vary with the location of the stream. If it flows across the property from front to rear, the value of the land reclaimed will be the width times the front foot value of the land. If it flows parallel to the front line, the value will decrease with its distance from the front. In this calculation the land is divided into four strips and that in front given 40% of the value of the entire property, the next strip 30%, the next 20%, and the rear strip 10%. After studying property values in the improved sections, $25 was taken as a fair front foot value for use in stream reclamation.



TOP: *Schematic diagram showing flood relief benefits.* MIDDLE: *Sketch of drainage area of Pine St. sewer.* BOTTOM: *Sections through Pine St. brook at three points.*

Stream bed reclamation involves an expenditure on the owner's part for filling in the brook-channel (unless this be done by the municipality) and credit was allowed for this expenditure in computing reclamation assessments, the cost of filling per cubic yard being assumed at double that of embankment because of the smaller quantities involved.

Calculation of Assessments

In calculating the assessments, the engineers added together the several benefits—service (lateral sewer), flood relief, land reclamation, and general drainage area, and deducted credit for cost of stream bed reclamation. The first was figured at 68 cents times the frontage; the second at 35.9 cents per cubic yard of fill; stream bed reclamation was figured as described.

For example, a lot 80′ front by 107′ depth had a stream 7′ wide in the rear fourth. The value of the lot was 80 x $25=$2,000; of the rear fourth, $200. The stream bed area was $\frac{7 \times 4}{107}$ of the rear fourth and its value was this times $200, or $52.24.

The credits were figured on cost of filling stream; averaging about 30 cts. per lineal foot of stream; in the above example, $23.70.

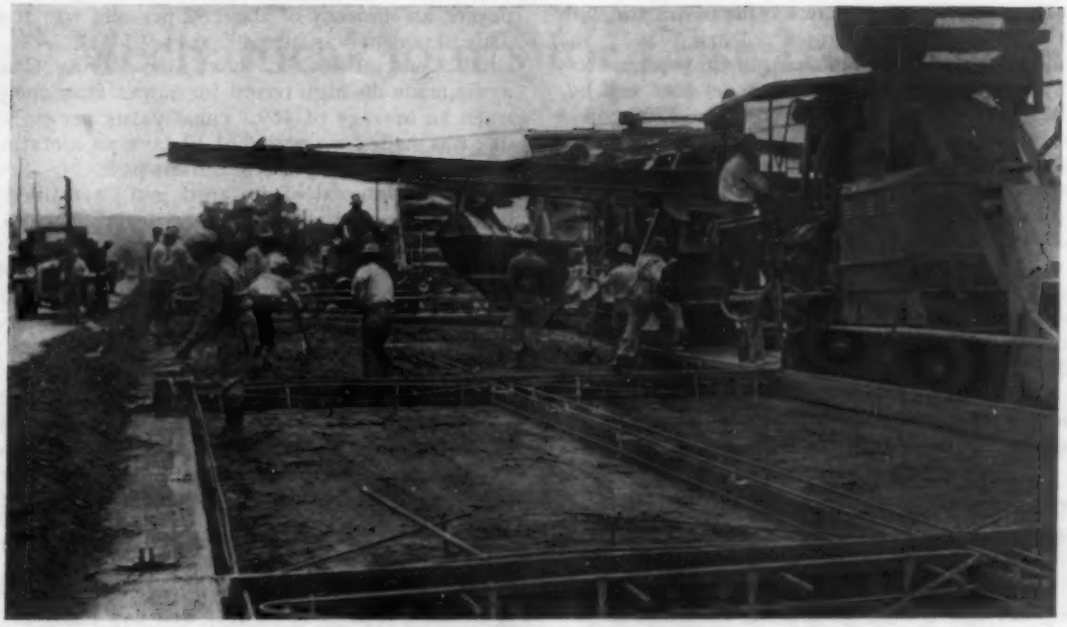
Sufficiency of Storm Drainage

As the benefits depend largely upon the relief from floods conferred by the improvements, it was necessary to estimate the sufficiency of such relief. In this, the engineers used the rational method of calculating run-off, first studying the available rainfall records and from them plotting rainfall-duration curves for storms of 1, 2, 3, 5, 10, 20 and 40-year frequency. They assumed that the sewer should carry the maximum run-off from storms of 5-year frequency to meet generally accepted requirements.

One sewer, draining 745 acres, was calculated to have a capacity of 240 c f s. near its upper end but only 100 c f s. near the lower end because of very flat grade, increasing to 275 c f s. at the outlet. It was calculated that this sewer in the flat grade could not handle floods greater than those of one-year frequency, and should have had nearly 3½ times this capacity to handle those of 5-year frequency. There was therefore no benefit to the drainage area as a whole.

At the upper end there was considerable benefit to abutting property; but at the lower end there was none at all "due to the fact that pipe lines for local drainage are at such elevations that backwater flooding is possible from the new sewer"; in fact, over one stretch of the sewer "backwater flooding actually raises the elevation of the water in the natural channels which still exist to a point higher than that which would have occurred under the same flow in the natural stream."

Somewhat similar conditions were found in the other three districts, and no general drainage area assessment was considered warranted, while the flood relief benefits were much less than they might have been. As a result, the assessments totaled only $11,928, while the cost of the sewers to the borough was $128,345. The balance is the cost to the taxpayers at large of the inadequacy of the sewers due to faulty designing.



Two mixers in operation in San Mateo County, laying cement concrete pavement

California Pavement Records and Construction Progress

By Earl Withycombe
Assistant Construction Engineer

THE years 1931-32 were a period marked by economy and efficiency in the construction of high-type pavements, greater speed of production, and better riding qualities of the finished product. This was due to improved methods and technique of the engineers of the Division of Highways, modern equipment used by the contractors, and effective cooperation between engineers and contractors.

Research Projects

Two sections of 40′ x 11-9-11″ pavement were built, one 1,016′ and the other 1,184′ in length, divided into 17 separate subsections, and using six different brands and 17 different kinds of cement. An earth cushion varying from 2″ to 18″ thick was placed over the old macadam pavement, and watered, rolled and shaped. No reinforcing steel was placed, and no transverse joints other than a 2″ expansion joint in each main section. Strain meters and temperature coils were placed in each section, this work being done under the direction of the Testing and Research Laboratory.

The second project was in Placer County, Newcastle to Wise Power House, and involved the use of wire mesh reinforcing in place of the standard ½″ marginal bars. 2.3 miles of 20′ and 0.4 mile 30′ width, 9-7-9″ thick were constructed with wire mesh reinforcing and expansion joints 40′ apart, but with no dummy joints.

On this particular project, the cost of placing wire mesh was less than for placing marginal bars, but this was offset by the added cost of mixer delays, traffic interference, etc., due to placing mesh. A second wire mesh project is now being constructed in Santa Clara County near Sunnyvale, which will be subject to much heavier traffic conditions than the Newcastle pavement.

Portland Cement Concrete Speed Records

During 1931, the maximum average daily yardage of concrete, using one mixer, was placed on Contract 43CN3, in Colusa County between Williams and Maxwell, where the Union Paving Company placed 467.3 cubic yards per 8-hour day; two machine finishers were used. E. J. Peterson was resident engineer, with A. C. Briney, assistant on the street. The maximum output for two mixers was on Contract 24TC7, in San Mateo County between Burlingame and San Mateo, where Basich Bros. placed an average of 853.4 cubic yards per day. W. A. Rise was resident engineer, with E. Carlstad on the street. Three machine finishers were used.

During 1932, the largest one-mixer output was on Contract 46CS1, between Tipton Crossing and Tulare, where the Union Paving Company averaged 467.9 cubic yards per day, using two finishers. W. T. Rhodes was resident engineer with P. A. Boulton on the street. For two mixers, the California record was broken on Contract 44TC2, Redwood City to Oregon Avenue in San Mateo, by Basich Bros., who placed an average of 880.7 cubic yards in eight hours, using two finishers. W. A. Rise was resident engineer, and F. W. Montell was street assistant.

Other Cement Concrete Records

The strongest concrete placed during 1931 was on Contract 27FC15, at Galivan Crossing in Orange County, where an average breaking-strength of 6547 pounds

was obtained. Griffith Company was the contractor, with W. J. Calvin, resident engineer. During 1932, the maximum average breaking strength of concrete was on Contract 47VC3, between Corona del Mar and Laguna Beach, also in Orange County, where 5708-pound concrete was placed by Jahn and Bressi under direction of W. D. Eaton, resident engineer.

The record for cement control during 1931 appears to be on Contract 45FC1, between Wigmore and Los Alamos, in Santa Barbara County, with an average daily variation of 0.25 per cent; Basich Bros., contractor, and E. W. Taylor, resident engineer. During 1932, another District V contract, 45CS2, had the best cement control with 0.18 per cent variation, this being in Santa Barbara County between 2 miles north of Solomon Summit and 1½ miles south of Santa Maria; Fredrickson and Watson, contractors, and J. C. Adams, resident engineer.

Smoothness of Concrete Pavement

The record for surface smoothness in 1931 was made on Contract 27VC11, La Posta Creek to Campo Road Junction, San Diego County, with a roughness of 6.6 inches per mile; contractor, E. Paul Ford; resident engineer, C. P. Montgomery. During 1932, the smoothest surface, 5.8 inches per mile, was obtained on Contract 47VC9, Rose Canyon to Sorrento Creek, also in San Diego County; B. G. Carroll, contractor; R. J. Hatfield, resident engineer.

1932 Construction

During 1932, the average daily concrete pavement output was 420.8 cubic yards with an average compressive strength of 4665 pounds, as compared to 3595 in 1931. Cement control averaged 0.71 per cent, about the same as in 1931. The average surface smoothness was 9.0 inches per mile, an improvement over 1931, which showed 10.5.

Two pavers were used on four contracts, two of which were 10′ construction; while on 16 contracts two finishing machines were used. On Contract 44TC2, 7.5 miles of Bayshore highway south of Redwood City, the average for 44 eight-hour days was 880.7 cubic yards. This exceeded the 1931 record made by the same contractor, Basich Bros., by 27.3 cubic yards, a new high record output. Based on 480 cubic yards capacity for these pavers, an efficiency of about 92 per cent was attained. This pavement was also 40′ x 11-9-11″.

On Contract 46CS1, the Union Paving Company again made the high record for output from one paver, when an average of 469.7 cubic yards per eight-hour day was made for a period of 39 days, an operating efficiency of about 98 per cent on this paver.

The 20′ interval of designed joints remained standard with few variations. Several deviations were made in experimental sections within contracts, one of which was to eliminate designed joints entirely. Sufficient time has not elapsed to form any definite conclusions. Several projects were constructed with 20′ interval on contraction and 400′ interval on expansion joints.

Difficulty has been experienced in the past with localized heaving at designed joints over adverse soils due to water penetrating the subgrade through the joints. Considerable experimenting is under way to develop a satisfactory method of sealing, and more attention is being paid to selection and treatment of subgrade materials than in the past.

New Finishing Methods

Finshing has been improved by lengthening the one-man floats from 10 to 16 feet, and new methods of finishing are continually being tried and as improvement is made the practice becomes standardized. For example, on Contract 43CN3, Williams to Maxwell, the roughness averaged 13.7 inches per mile. The same contractor had an adjoining contract, 43EC3, Maxwell to 4 miles southerly, and paving was started immediately following the completion of 43CN3.

On the second project the resident engineer made a deviation in joint construction in an endeavor to improve the riding qualities. The joint finishing tool was mounted on a float board to prevent cutting below the general surface of the pavement, and the final finish float was used behind the edging of joints to true up any irregularities. The second project averaged 7.3 inches per mile in surface roughness, or a decrease of 6.4 inches per mile.

This article was abstracted from California Highways and Public Works, publication of the California Highway Department. The second installment, dealing with bituminous construction, will appear next month

Sixteen foot one-man finishing float on P. C. C. pavement

Mechanical Joints for Cast Iron Pipe

Advantages of such joints and conditions for which they are considered to be especially suitable. Descriptions of the several styles available.

By Harvey R. Cook

TWO of the oldest utility services in this country, water and gas, have been large users of cast iron pipe. The bell and spigot type of joint has been used by both for most of the pipe laid but interest in the mechanical type of joint has been increasing rapidly during the last ten years; this interest manifesting itself first in the gas industry and later in water works engineering.*

Some mechanical joints are recommended by their sponsors for both water and gas under every condition. Others, while employed chiefly for gas, are being used for water lines also, especially where difficult situations are encountered, such as uncertain foundation soil, exposure to changes in temperature, subaqueous lines, necessity of prevention of leakage, etc.

Coupling Style Joints

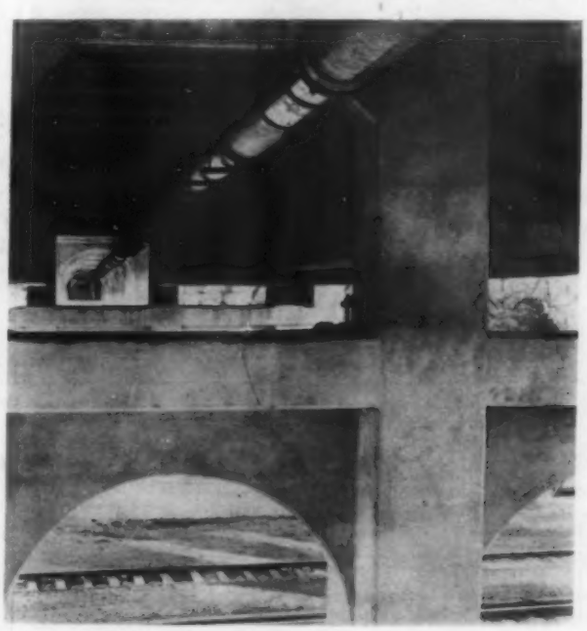
Mechanical type joints are of two general classes: the older coupling style, which is made entirely separate from the pipe by companies specializing in the manufacture of couplings; and the more recent gland style, which is cast in part as integral with the pipe and sold by the manufacturers of cast iron pipe. Both have wide variation in design.

The Dresser Mechanical Joint or Sleeve Coupling was initially invented by S. R. Dresser in the late eighties; since then it has undergone an extensive development and today is available in numerous modified forms to take care of both ordinary and special situations of pipe line construction. As made today, the style of Dresser Coupling which is standard for a great deal of pipe laying consists of a middle metal ring or sleeve, two wedge-shaped rubber rings or gaskets and two metal follower rings or flanges, together with bolts and nuts, the number of which varies with the sizes of the couplings. This is the only type of mechanical joint that utilizes two rubber rings. In assembling the joint, a flange and then a rubber gasket are slipped over each end of two lengths of plain-end pipe. The middle ring is placed on the end of one length of pipe, after which the end of the other length is inserted into the middle ring. Bolts are run through the holes in the follower flanges and the nuts screwed on. To insure uniform compression on the gaskets, diametrically opposite bolts are drawn up with a ratchet wrench until all are tight. Where large-diameter pipe lines operate under high heads of water, the Dresser coupling has been modified with a stuffing box design. For repairing defective bell and spigot joints, the Dresser Manufacturing Co. makes a repair clamp employing a unique principle.

Dresser couplings were used on water lines for the first time more than thirty years ago, and their use on water lines has had a particularly rapid growth within the past few years.

Another coupling of the same style has been made since about 1906 by the Dayton Pipe Coupling Company, of Dayton, Ohio.

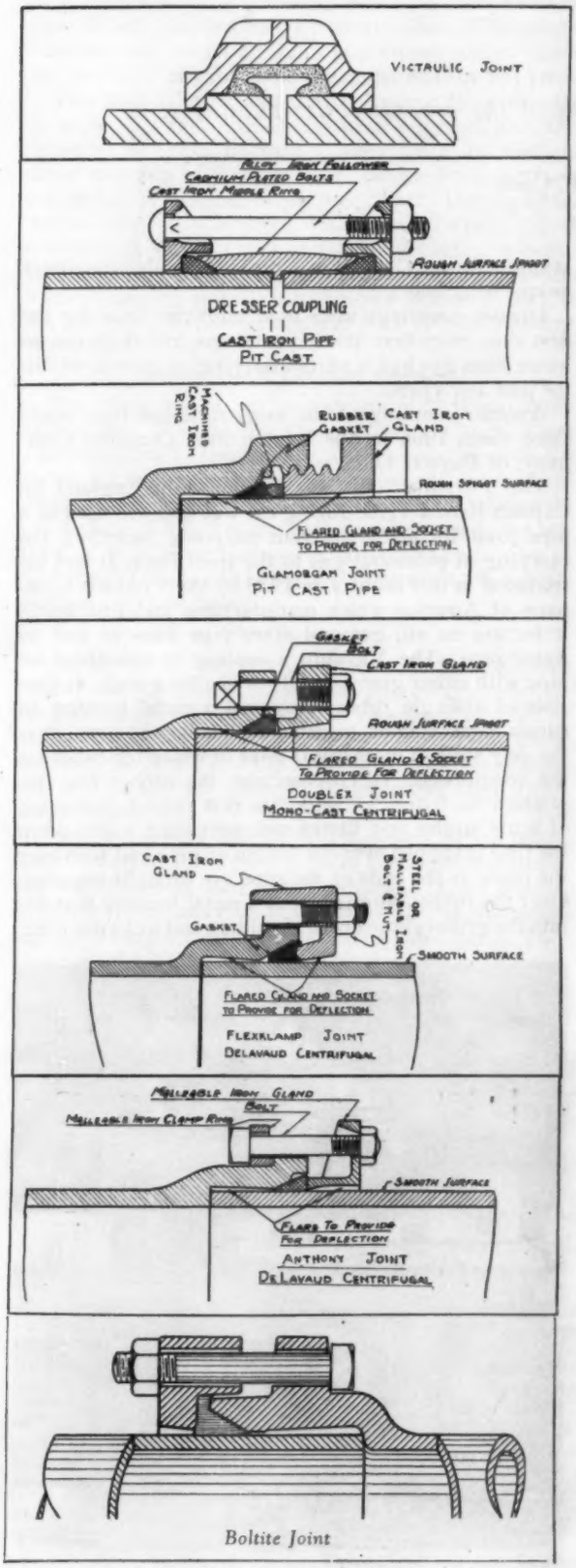
The Victaulic joint was developed in England by Captain Ernest Tribe during the war and was used as a pipe joint for many different purposes, including the carrying of poisonous gas to the front lines. It was introduced in this country in 1925 by the Victaulic Company of America which manufactures and distributes it for use on oil, gas and other pipe lines as well as water pipe. The Victaulic Coupling is assembled on pipe with either grooved ends or shoulder ends. It consists of a single rubber ring and a metal housing in two or more sections, together with bolts and nuts. It is the only style of mechanical joint in which the rubber is not compressed. In cross-section, the rubber ring resembles the letter "C" with lips that extend downward at acute angles and flatten out, providing a seal when the ring is slipped over one length of pipe and then over the other as the ends of the pipe are brought together. Over the rubber ring is placed a metal housing that fits into the grooves or over the shoulders and locks the joint.



Anthony-jointed pipe suspended under bridge

*Both utilities also use steel pipe, and for this have employed mechanical joints (either Dresser or Victaulic), welding or riveting. Also screw joints are used with both steel and cast iron, and welding of cast iron is possible but not extensively used. This article is limited to mechanical joints for cast iron pipe.

The housing is in two parts for pipe up to 14 inches in diameter, and in three or more for the larger sizes of pipe. When there are more than two sections, they are assembled into two groups before being placed around the pipe. Unlike other mechanical joints, which have bolts parallel to the pipe, the bolts of the Victaulic coupling are at right angles to the pipe and are tightened with a key wrench instead of a ratchet wrench. The ends of the pipes are shouldered or grooved at the mill or the pipe can be grooved in the field with the same power equipment used for threading pipe, making possible the use of salvaged pipe.



Sections of various mechanical joints

Both the Dresser and Victaulic couplings are manufactured for either water or gas lines and for use with steel or wrought iron pipe as well as cast iron pipes.

Gland Style Joints

All the gland style joints consist of a bell with an inside contour to allow for deflection, a plain end spigot and a single rubber ring which is compressed in, or in and against, the bell by a movable gland or follower ring secured to or behind the bell with bolts, or, in one case, by a coarse thread. Also, to provide for deflection, the base of the follower ring is at an angle to the pipe, the degree of the angle varying with the different joints.

Of the present gland style joints, the oldest is the Anthony, first manufactured by the United States Pipe & Foundry Company, and now also by the Lynchburg Foundry Company. As used today with deLavaud pipe, the Anthony joint has a split clamp ring that fits behind the bell and is bolted to the metal follower ring. After this and a rubber gasket have been slipped over the plain end of the pipe, the spigot is inserted in the bell and the clamp ring is placed behind the ridge of the bell. As the bolts are tightened, the bottom of the follower ring, the cross-section of which is "L" shaped, pushes against the gasket and compresses the rubber into the bell. Originally there was also provided, for sand-cast pipe, an integral flange style in which, instead of the split clamp ring, a flange was cast on the outer circumference of the bell.

This same general design with the flange cast on the bell is employed by the American Cast Iron Pipe Company; its Doublex Simplex joint for Mono-cast pipe was introduced about 1928. However, the dimensions and details of the various parts of the joint are different, such as a beveled instead of a flat end on the spigot, and a solid instead of a ribbed follower ring. The Doublex Simplex joint is a further development of the modified bell and spigot Simplex joint, which the company placed on the market in 1919.

The Flexklamp joint, also announced about 1928 and known originally as the Carson joint, is manufactured by the National Cast Iron Pipe Company and by James B. Clow & Sons. The bell is cast with a square shoulder, onto which hooks an "L" shaped malleable iron bolt which passes through a metal follower ring. Designed so that the inner and rounded edge presses into and against (instead of just against) the wedge-shaped gasket that is placed over the plain end spigot, the follower ring extends back over the bolt and bell of the pipe as a protection for the bolt against corrosion as well as to keep the bolt secured against the back of the bell.

In the Boltite joint of the McWane Cast Iron Pipe Company, the flange is cast in the center of the outer circumference of the bell, and the rubber gasket, instead of being wedge-shaped and entering entirely into the bell extends also out over the face. The follower ring partly covers the protruding portion of the bell.

Victaulic couplings on viaduct

Instead of being held by bolts, as in the other joints, the follower ring or gland in the Glamorgan joint, made by the Glamorgan Pipe & Foundry Company, has a coarse thread that screws into the bell. This gland, which more resembles a sleeve, fits against a machined cast iron ring that presses against the triangular rubber gasket. The joint is prepared by holding the pipe with chain tongs and applying a special spanner wrench, and the A. G. A. Testing Laboratory in a recent report stated that "considerable force was necessary to secure a tight joint with this arrangement."

The rubber rings for these mechanical joints vary somewhat in shape. Those for the Anthony and Dresser joints have rounded corners, the curves on the former being not quite so sharp. Those for the Doublex Simplex are flat at the front and top, and those for the Flexklamp are somewhat similar with the additional feature of a curve in the back to fit the follower ring. All are of specially compounded rubber. Plain rubber gaskets are recommended for water pipe. There is ample evidence of the durability of these rubber rings. Confined in a joint where dampness, darkness and low temperatures prevail, the rubber is protected from its natural enemies: namely, heat, light and lack of moisture. In Germany, France and England, rubber rings removed from pipe joints after 50 years or more of service have been found to be in an excellent state of preservation. In Elizabeth, N. J., a few years ago, a rubber ring was removed for inspection from a "Clark patent joint" which had been installed on the mains of the Elizabethtown Consolidated Gas Company in 1870. The rubber had kept its form remarkably well and had good resilience. On a water line in Bradford, Pa., which had been in continuous service since 1910, two rubbers were removed from a Dresser joint two years ago, which, with the exception of a thin, hard coating on the outside, showed no signs of deterioration and appeared to be just as resilient as when they were installed twenty-two years before.

Another question often raised is about the life of the bolts as relating to the permanence of the joint. Besides cast iron, bolts which are plated with cadmium (practically encased bolts) and other corrosion-resisting alloys are used. But even should the bolts rust away, it is unlikely that the joints would be weakened to any great extent. On old dismantled gas transmission lines, the rubber rings were found to have become so firmly "frozen" in the joint that they had to be cut out with cold chisels. In a test with an eight-inch Dresser joint from which the bolts and follower flanges had been removed, an internal hydrostatic pressure in excess of 500 pounds per square inch was applied before the rubbers were forced out of the recesses in the joint, although the joint had been assembled less than 24 hours; in other words, the rubber gaskets held this pressure without the bolts, follower rings or end flanges.

Mechanical joints of the coupling style have been supplied in sizes up to 72 inches and are considered applicable to even larger sizes. Of the gland style, sizes are quoted up to 24 inches.

Advantages of Mechanical Type Joints

To understand the reason for the trend toward mechanical-type joints, it is necessary to compare them with the bell and spigot type.

The bell and spigot type is made in the field, under varying conditions of weather, with more or less elaborate equipment for heating, pouring and caulking. Mechanical joints are made in factories under uniformly controlled conditions and are assembled in the field with a single tool, a ratchet wrench or key wrench (except in one style where a coarse thread is employed).

Although the bell and spigot type joint has been used for a great many years and undoubtedly will continue to be employed, it is not without certain disadvantages, chiefly the inability of a rigidly jointed pipe line to always withstand the strains due to vibrations, shifting soil and other conditions found in modern streets. Despite their shorter histories, it is pretty well known what may be expected from mechanical joints, particularly the older ones, and it can not now be questioned that they are worthy of serious consideration for ordinary usage as well as for solving special problems.

During the past year the American Gas Association

36-inch water pipe with Dresser couplings, laid by the St. Louis Water Department in 1931. Operating under approximately 200 pounds working pressure

Testing Laboratory completed a series of tests on bell and spigot and on mechanical joints for the Cast Iron Pipe Research Association. These were primarily for gas service; but it is easier to make a joint water tight than gas or air tight, and the characteristics and conditions which cause a leaky joint for one apply in general to the other service also. While pressures in municipal gas distribution systems are much lower than in water mains, transmission lines for natural gas carry pressures up to several hundred pounds.

This laboratory reported that, for bell and spigot joints:

"Cast lead joints are not considered satisfactory for new construction. Lead offers little resistance toward deformation and is unable to return to its original position when once deformed. Lead joints are thus likely to leak rapidly. Lead wool joints are expensive to prepare and it is doubtful whether they can be depended on to stand up under service conditions. The objection to the use of cast lead applies to a certain extent to lead wool. This may be overcome somewhat by more effective caulking, such as by air tools. The workmanship in the preparation of such joints is of great importance."

"Mechanical joints, such as Anthony, Dresser, Doublex-Simplex and Flexklamp, all of which make use of rubber rings as gaskets, are recommended for use with cast iron mains for pressure above 25 pounds. These have been tested out and found tight for pressures up to 150 pounds under conditions even more rigid than those used for bell and spigot joints."

As to the hydrostatic pressures that mechanical joints will stand, some of them have been tested up to 1,600 lbs. per square inch without showing any signs of leakage. In a 1,000-mile natural gas transmission line, Dresser joints handled an 800 lb. working pressure.

The primary causes of leaky pipe joints include ground settlement, lateral shifting of the ground, transmitted vibration, temperature changes, and faulty field workmanship. Flexibility in a pipe joint affords protection against shifting ground, and this is possessed to a greater extent by mechanical than by bell and spigot joints, and the former withstand torque when force is applied in more than one direction. When a line of bell and spigot pipe is deflected and returned to its original alignment, the lead or other jointing material is deformed and often so loosened as to blow out unless the joint is uncovered and remade; but in the case of mechanical joints, the rubber rings retain their resilience for an extremely long period of time, changing their shapes and adhering tightly to the pipe whenever the joints are deflected. There are records of rubber rings having been in pipe line service for over fifty years without showing signs of deterioration or loss in functional resiliency when removed.

Doublex Simplex joints at Tupper Lake, N. Y.

Leakage is often due to vibration from traffic in the street above. The A. G. A. laboratory conducted a survey with a telemeter on 8" and 12" pipe lines and found that street cars caused the greatest vibration in pipe, that due to other traffic being slight in comparison. Larger pipe with flatter arches will be more greatly affected than smaller pipe. Where vibrations occur, the flexibility of the mechanical joint is a decided advantage.

Expansion and contraction due to temperature changes are taken care of by mechanical joints by their flexibility, while the rubber ring forms a cushion and seal to keep the joint tight if the pipe moves longitudinally.

Leakage in bell and spigot joints is often due to the manner in which they were made up in the field. The personal equation in pouring and caulking joints is an important factor in securing tightness; while, on the other hand, nothing is simpler or more uniform or offers less chance of error than slipping on metal rings and rubber gaskets and drawing them together by means of bolts. This simplicity is especially desirable where the pipe laying is done by labor recruited from the unemployed who are without skill or experience in pipe laying.

The equipment and preliminary preparation required for installing mechanical joints consists only of a ratchet or key wrench (except for the one that employs a thread), as compared with the melting pots, furnaces, fuel, ladles, runners, pouring gates and caulking tools required for bell and spigot joints. In extremely cold weather, it is sometimes necessary to heat large pipe to avoid misses with poured joints, while the mechanical joint is installed as easily in one kind of weather as in another.

The mechanical joint can be made more quickly, and the trench can be backfilled as soon as the joints have been made and tested. The holes excavated for operating a wrench need not be as large as bell holes.

In mountainous and rolling country, the flexibility of mechanical joints allows the pipe to follow the contours of the ground laterally and vertically, eliminating the need for special bends.

The ease and speed with which mechanical joints of the sleeve type can be put together or taken apart are advantages on temporary lines and in quick repairing and replacements; in relaying mains; in cleaning mains; and in replacing damaged lengths, cutting in valves and fittings, and making repairs of any kind.

Cost

The initial cost per linear foot of a cast iron pipe line will average about 5% more than bell and spigot when laid with some types of mechanical joints, on the smaller diameters up to 12-inch, figured with present day prices; while for other types the cost will run somewhat higher.

The additional cost per linear foot of pipe increases progressively with diameter increase, in the use of cast iron pipe with mechanical joints; and decreases progressively, with diameter increase, in the use of steel pipe with steel mechanical joints or couplings.

Considering the advantages of the mechanical joint, including low cost and economical operating performance after installation, the slightly greater initial cost still gives a total annual cost which makes an excellent economic showing; which is indicated by the fact that hundreds of thousands of such joints have been installed.

Do you make full use of the Readers' Service Dept.?—see pp. 47-50

State Highways and the National Recovery Act

DURING the past month, PUBLIC WORKS has been in close contact with the Federal Emergency Administration of Public Works, with the Bureau of Public Roads, and with the various state highways departments. The following information has been obtained up to and including the last day of July, covering funds available, percentage of distribution and types of surfaces to be laid.

Information Regarding Work

Alabama: Allotment, $8,370,133. No further information available.

Arizona: $3,804,000 on FA highways; $782,000 on extensions of FA highways through municipalities; and $625,000 on secondary or feeder roads. There will be work in all 14 counties in the state.

Arkansas: The distribution of funds will be, respectively, 50%, 25%, and 25%. Total allotment, $6,748,335, to be spent in 59 of the 75 counties.

California: Allotment, $15,607,354. Distribution, 50%, 25%, and 25%. Money to be spent in 50 of the 58 counties.

Colorado: Allotment, $6,874,530. No further information.

Connecticut: Allotment, $2,865,740. Distribution, 49%, 28%, and 23%. Money will be spent in 7 of the 8 counties.

Delaware: $1,819,088. Distribution, 50%, 25%, and 25%, with money to be spent in all 3 counties. Construction, about 75 miles, mostly concrete.

Florida: $5,231,834; distribution, 50%, 25%, 25%; money to be spent in 52 of the 67 counties.

Georgia: Allotment, $10,091,185. No further information.

Idaho: $4,486,249. Distribution, 50%, 25%, and 25%, to be spent in 35 of 44 counties.

Illinois: $17,570,770; distribution, 26%, 46%, and 28%.

Indiana, $10,037,843; distribution, 48%, 47%, and 5%, with work in 68 of 92 counties.

Iowa: $10,055,660; distribution, 50%, 28%, 22%, with work in all 99 counties.

Kansas: $10,089,604; distribution, 50%, 25%, 25%, with work in probably all of the 105 counties.

Kentucky: $7,517,359; distribution, 48%, 27%, 25%, with work in 97 of 120 counties.

Louisiana: $5,828,591; distribution, 50%, 25% and 25%, with work in 56 of 64 parishes. Plan 60 miles concrete, 15.4 miles asphalt surface treatment, 49.1 miles miscellaneous types and 10 bridges to cost $972,500, all on FA roads outside municipalities. Municipal projects, 32.3 miles concrete, 15 miles asphalt surface treatment, 22.3 miles miscellaneous types, and 4 bridges to cost $226,000. Secondary roads, 14.9 miles concrete, one bridge to cost $300,000, and miscellaneous surfacing types to cost $594,400.

Maine: $3,369,917; distribution, 50%, 25% and 25%, with work in all 16 counties. Tentative program, 2.7 miles concrete, 23 miles bituminous macadam, 17 miles gravel, 14 miles shoulder widening, and 8 bridges.

Maryland: $3,564,527; no further information.

Massachusetts: $6,597,100; distribution, 27%, 64%, and 9%, with work in 11 of 14 counties. All construction will be modern high type pavement.

Michigan: $12,736,227; distribution, 40%, 35% and 25%, with work in 65 of 83 counties.

Minnesota: $10,658,569; distribution 48%, 32% and 20%, with work in 81 of 87 counties. Detailed program submitted increased municipal projects to 40%. Tentative program, 1,250 miles low cost bituminous surfacing, 52 miles of paving, 20 miles repaving, and 325 miles of grading.

Missouri: $12,180,306; distribution, 50%, 25% and 25%, with work in 92 of 114 counties.

Mississippi: $6,978,675; distribution, 50%, 25% and 25%, with work in 62 of 82 counties.

Montana: $7,438,748; distribution, 50%, 25% and 25%, with work in 46 of 56 counties.

Nebraska: $7,828,961; distribution requested, 62½%, 12½% and 25%, probable final distribution, 50-25-25, with work in 76 of 93 counties. General program, 150 miles hard surface pavement, 350 miles bituminous mat surfacing, 200 miles sand-gravel surfacing, and 50 bridges. The surfacing mentioned will require about an equal mileage of grading, and small structures.

Nevada: $4,545,917; distribution, 64%, 11% and 25%, with work in 16 of 17 counties.

New Hampshire: $1,909,839; distribution requested, 34%, 39% and 27%, with work in all 10 counties. Tentative program, 5 miles gravel, 9 miles bituminous macadam, 18 miles concrete, 30 miles surface treated gravel, and 6 bridges.

New Jersey: $6,346,039; distribution not given; reported outline calls for 69.3 miles concrete. Work in 14 of 21 counties.

New Mexico: $5,792,535; distribution, 50-25-25, with work in all 31 counties. Tentative plans, 750 miles, graded and drained, gravel and oil process, with some concrete.

New York: $22,330,101; distribution, 54.8%, 25.2% and 25%. About 450 miles, concrete and bituminous.

North Carolina: $9,522,293; distribution, 50-25-25, with work in 75 of 100 counties. Tentative plans, 350 miles topsoil, sand-clay, gravel and bituminous surfacing, 150 miles secondary and 450 mile primary surfaces of above types and also concrete, sand-asphalt and mixed-in-place.

North Dakota: $5,804,448; distribution, 50-25-25, with work in all 53 counties. Tentative plans, gravel and oiled gravel, with considerable grading.

Ohio: $15,484,592; distribution, 45-30-25, with work in all 88 counties. Tentative program, 200 miles FA projects, 100 miles secondary, and $4,600,000 for municipal work. $2,250,000 will be spent on bridges and $1,000,000 on grade crossing elimination.

Oklahoma: $9,216,798; distribution, 50-25-25, with work in all 77 counties.

Oregon: $6,106,896; distribution, 50-25-25, with work in 30 of 36 counties.

Pennsylvania: $18,891,005. No further information.

Rhode Island: $1,998,708; distribution, 50-25-25, with work in all 5 counties.

South Carolina: $5,459,165; distribution, 50-25-25, with work in all 46 counties. Estimate between 400 and 600 miles of construction.

South Dakota: $6,011,479; distribution, 50-25-25, with work in 67 of 69 counties. Estimate calls for about 45 miles concrete, 450 miles bituminous surfacing, 425 miles gravel surfacing, grading, and about $450,000 for bridges.

Tennessee: $8,492,619; distribution, 50-25-25, with work in 72 of 95 counties. Estimated mileage, 350, 40 and 400 respectively, with type of surfacing not determined.

Texas: $24,244,024; distribution, 50-25-25, with work in all 254 counties.

Utah: $4,194,708; distribution, 50-25-25, with work in 26 of 29 counties.

Vermont: $1,867,573; distribution, approximately 50-25-25, with work in all 14 counties.

Virginia: $7,416,757; distribution, 50-25-25, with work in 91 of 100 counties.

Washington: $6,115,867; distribution, 50%, 30.7% and 19.3%, with work in 34 of 39 counties. Plan about 220 miles concrete, macadam and oil macadam.

West Virginia: $4,474,234; distribution, 45-30-25, with work in 46 of 55 counties. There will be about 120 miles primary and 130 miles secondary types, including concrete, macadam and surface treated.

Wisconsin: $9,724,881; distribution, 50-25-25, with work in all 71 counties. Estimated mileage, 150 of concrete, 450 of bituminous surfacing and 70 of grading and graveling.

Wyoming: $4,501,327; distribution, 50-25-25, with work in all 23 counties.

Maintenance Requirements

The regulations under which this money is distributed provide for agreements for maintenance of secondary or feeder roads and of FA extensions into municipalities by the states, where the law permits the states to undertake such maintenance. Where it does not, the county, municipality or other political subdivision must agree to assume this. In none of the reports received from states was it believed that any difficulty would arise over this requirement.

Other Important Provisions

Among the important provisions contained in the rules and regulations of the Bureau of Public Roads concerning construction were that there should be no preference for local materials; that no convict labor should be employed, nor materials produced by convict labor used; that predetermined minimum wages shall apply on all contracts; all wages are to be paid in cash; and preference to employment shall be given ex-service men with dependents, and local labor.

Other provisions include those for hand labor, outlined in PUBLIC WORKS for July, for the 30-hour week, with certain liberalizing provisions, for the certification of pay rolls, for the use of such unmanufactured materials as have been produced in the United States, and the requirements that general contractors shall perform at least 80% of the work with their own forces, excepting certain highly specialized work, and that no restrictions shall be placed on non-resident contractors.

The State Highway Systems

According to information just released by the Bureau of Public Roads, 29,577 miles of state highways were completed in 1932. On 19,568 miles, the surfaces laid were of such types as sand-clay, gravel and water-bound macadam; in addition there were 1,466 miles of bituminous macadam, 1,476 miles of bituminous concrete and sheet asphalt, 6,194 miles of portland cement concrete and 153 miles of block types.

In the 358,210 miles in the state highway systems, only 109,735 miles were high-type surfaces, such as bituminous macadam, bituminous concrete, portland cement concrete and block types; 156,325 miles were of low type surfaces, including sand-clay, top-soil, gravel and water-bound macadam; and 92,150 miles were still unsurfaced.

Only three states have completed their highways systems, Maryland, Massachusetts and Vermont, though several others are closely approaching the adopted system.

Trade Wastes and Sewage Treatment

Information regarding troubles in sewage treatment plants due to various trade wastes was recently obtained through the courtesy of a number of city engineers. One question had to do specifically with the effect of laundry wastes on treatment plants. As might have been expected, considering the relatively small proportion of these wastes to the total volume of sewage flow, not many engineers reported difficulties. In all, troubles of greater or less degree were reported by 19 cities as due to laundry wastes. In some cases, it was the combination of these wastes and other trade wastes that caused trouble.

Foaming of tanks, excessive amounts of grease and soap, failure to clarify, boiling of tanks, and septic action in tanks were among the causes listed as being due chiefly to the presence of laundry wastes.

In all, difficulties due to trade wastes were reported by 93 cities, or about 10% of those reporting. The following causes of trouble were reported: Alcohol wastes, 2; cannery wastes, 6; garage, filling station wastes and miscellaneous oils, 24; wool wastes, 2; creameries, 9; oil from factories, 4; pickling plants, 2; oil refineries, 2; apple acids, 1; steel mills, 1; packing plants, 5; dry cleaners, 3; tanneries, 1; hosiery and knitting mills, 2; rubber packing wastes, 1; malt wastes, 1; produce plants, 1.

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Such a preponderance of filling stations and garages in the list of trouble makers is to be expected. Information regarding pre-treatment of sewage to eliminate operating troubles from such wastes was contained in an article by Frank C. Roe in the July issue of PUBLIC WORKS. Perhaps the most unexpected major source of trouble was that due to creamery and milk wastes. Some work has been done on this subject, but not much definite information appears to be available regarding methods of coping with the problem, so far as the small plant operator is concerned. It is believed that milk wastes are an important factor in preventing completely satisfactory operation in a number of such small plants.

Some experimental work is now being carried on with laundry wastes treatment. The wastes being studied are produced by a small plant located in an unsewered village and operating only during the summer. The problem is complicated by the fact that unnecessarily large amounts of washing compounds, soap, etc., are employed in operation. From the results already obtained, it is believed that a satisfactory degree of treatment can be obtained at a reasonable cost and with a minimum of operating attention. When the experimental work has been concluded, a report will appear in these pages.

Leakage in Long 36-Inch Cast Iron Water Line

PROBABLY the longest 36-in. cast-iron water supply line in the United States was recently completed for the Lincoln, Neb., Water Department to carry water to that city from the Plate River valley near Ashland. The main pipe line is 25.1 miles long, and a well pipe line 3.7 miles long varying in size from 24 in. to 36 in. was also constructed. All joints were poured with lead and calked over dry braided hemp or jute by means of compressed air hammers.

The contract provided that maximum permitted leakage on completion should be 100 gallons per inch of diameter per mile for 24 hours, as this is a pumping line and joint leakage had to be held to a minimum. The pipe, tested in sections, showed the following results:

Section	*Length Lin. ft.*	*Leakage G.P.M.*	*Leakage, gal. per in. diameter per mile, per 24 hours*
A	51,200	2.46	10.16
B	29,700	2.24	15.95
C	31,600	0.90	6.02
D	20,100	1.41	14.83
Total	132,600	7.01	11.18

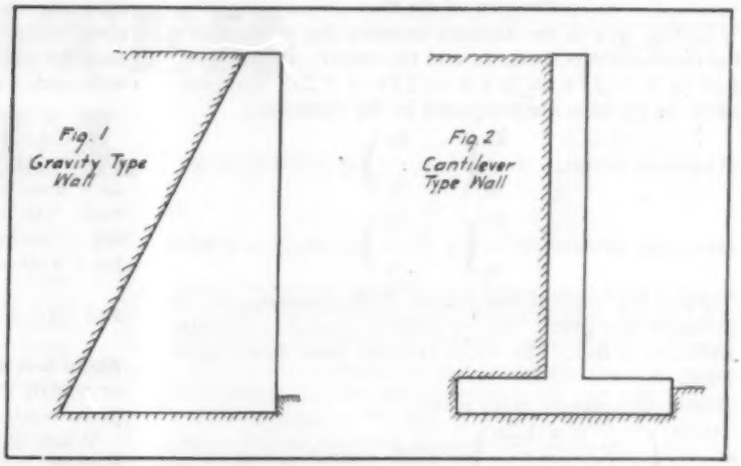
The same leakage requirement must hold two years after completion and 2 per cent is retained by the city from the contractor during this period.

Extension of Time for Completion of Highway Contract

The California Supreme Court holds, Oswald v. City of El Centro, 292 Pac. 1073, that a city could not justify its exaction from a contractor for a street improvement, in return for an extension of the time for the completion of the work, of a lease of a street-paving plant belonging to the contractor at a nominal rental, as a legitimate method of recoupment of a loss which the city claimed to have sustained because of inefficient work performed under other contracts made with the contractor some two years prior to the execution of the lease, no contractual relation existing between the two transactions. The lease was held void for lack of consideration. The damage was held to be the rental value for the term the owner had been deprived of possession.

Retaining Wall Design

A number of our readers have requested data on retaining wall design. This is one of three articles covering basic elements in design.



Typical forms of gravity and cantilever retaining walls

A RETAINING wall must be designed to resist: 1. Overturn; 2. Sliding on its foundation or footing; 3. Crushing or settling at the toe or heel; 4. Shearing horizontally at some point between the top and the bottom.

Pressure on Walls

The formula for fluid pressure against a lineal foot of wall is $P = \frac{1}{2}\ wh^2$, where P is the pressure applied horizontally to the wall; w is the weight per cubic foot of the material behind the wall (in the case of water, 62.5 pounds); and h is the height of the wall in feet.

The pressure P is the horizontal component of the pressure, which is normal to its face, no matter whether the face of the wall is vertical or sloping. The point of application of the pressure is always $1/3\ h$ from the bottom. Thus for a wall holding back 10 feet of water, the pressure per foot length of wall is:

$$P = \frac{1}{2}\ wh^2 = \frac{1}{2} \times 62.5 \times 10 \times 10 = 3125 \text{ pounds}$$

and this pressure is applied 3 1/3 feet from the bottom of the wall.

In the case of earth pressures, the formula is modified because of the fact that the angle of repose of the earth affects the pressure against the wall. When there is no surcharge, that is, when the fill behind the wall is level and at the elevation of the top of the wall, the formula for pressure becomes:

$$P = \frac{1}{2}\ wh^2 \tan^2 (45 - \frac{1}{2}\ \Phi)$$

where Φ is the angle of repose of the material behind the wall. If this is assumed to be 30°, and w is 110 pounds per cubic foot, then

$$P = \frac{1}{2} \times 110 \times 10 \times 10 \times \tan^2 30°$$
$$= 5500 \times (.57735)^2 = 1833 \text{ pounds}$$

Types of Retaining Walls

For the purpose of discussing design, two types of walls will be considered—the gravity wall and the cantilever or reinforced concrete wall. These are illustrated in typical forms in Fig. 1 and Fig. 2, respectively. These shapes are subject to considerable variation in actual practice. Generally, however, in order to save space, the face of the wall will be vertical or nearly so. In all cases the principles of design are similar and all walls must resist the forces mentioned in the first paragraph, no matter what their shape.

In Fig. 3, the weight of the wall plus the weight of the fill above the heel of the wall will resist the overturning tendency of the force P. So long as the resultant of these forces remains within the base of the wall, it will not overturn. In practice, however, the wall is so designed that the resultant of the forces passes within the middle third of the base. This is necessary in order to prevent tensile stress in the heel of the wall and excessive pressures at the toe.

Assuming the wall shown in Fig. 3, to determine its stability against overturning, the weight of the earth behind the wall being 110 pounds per cubic foot and of the masonry 150 pounds per cubic foot, with the angle of repose of the fill material 35°. Height is 15 ft.; top width 2 ft.; base width 8 ft.

Moments resisting overturn:

Section	*Weight*	*Lever Arm*	*Moments*
a d c e = 2x15x150 =	4500	1	4,500
c b e = ½x6x15x150 =	6750	4	27,000
c f b = ½x6x15x110 =	4950	6	29,700
	Weight = 16,200		Resisting Moments 61,200

Overturning moment:

$P = \frac{1}{2}\ wh^2 \tan^2 (45 - \frac{1}{2}\ \Phi) = \frac{1}{2} \times 110 \times 225 \times (.5209)^2 = 3360$ (approx.)

Lever arm = 1/3 h = 5. Overturning moment = 5 x 3360 = 16,800

61,200 — 16,800 = 44,400

44,400 ÷ 16,200 = 2.74′, distance resultant passes from toe of wall.

Location of middle third is 1/3 base = 1/3 x 8=2.67 feet from toe. Therefore resultant cuts base inside middle third and design of wall is satisfactory from standpoint of overturning.

As showing the importance of finding the correct figure for the angle of repose of the material retained behind the wall, let Φ in the above calculation be assumed as 30°. Then

$P = \frac{1}{2}\ wh^2 \tan^2 (45 - 15) = \frac{1}{2} \times 110 \times 225 \times (5773)^2 = 4125$

Lever arm is 5. Overturning moments are 5 x 4125 = 20,625

61,200 — 20,625 = 40,575

40,575 ÷ 16,200 = 2.504.

Therefore the resultant is not within the middle third and the base will have to be increased in width.

Pressure on the Base

In Fig. 4, e is the distance between the point where the resultant cuts the base, and the center. In this case, $e = \frac{1}{2}\ b - 2.74 = \frac{1}{2} \times 8 - 2.74 = 1.26'$. The pressures on the base are computed by the formulas:

$$\text{Maximum pressure} = \frac{Rv}{b}\left(1 + \frac{6e}{b}\right) \text{ or pressure at toe}$$

$$\text{Maximum pressure} = \frac{Rv}{b}\left(1 + \frac{6e}{b}\right) \text{ or pressure at heel}$$

Rv is the vertical component of the pressure, in the example just given, 16,200 pounds; and b is the base width, or 8 feet. The value of e has been shown to be $1.26'$.

Maximum pressure there is =

$$\frac{16{,}200}{8}\left(1 + \frac{6 \times 1.26}{8}\right) = 3{,}938 \text{ pounds per sq. ft.}$$

Maximum pressure there is =

$$\frac{16{,}200}{8}\left(1 - \frac{6 \times 1.26}{8}\right) = 111 \text{ pounds per sq. ft.}$$

It will be noted that when the resultant just cuts the edge of the middle third of the base, that the pressure at the heel will be 0, and that the pressure at the toe will be just twice the average pressure, or 2 x Rv ÷ b.

The safe pressures for each case must be determined by the particular soil conditions found. In walls of this sort, the ability of the soil to bear the load is the determining factor in limiting pressures, so long as the resultant is kept within the middle third of the base.

Resistance to Sliding

The horizontal component of the earth pressure tends to slide the wall forward on its base. The forces resisting are the weight of the wall and the friction of the base on the soil. In the example shown, the weight of the wall is 16,200 pounds per foot of length. The pressure against the wall, P, is 3,360 pounds per foot of length. Assuming a coefficient of friction of .35, the resistance to sliding is .35 x 16,200, or 5,670 pounds, which, divided by 3,360, gives a factor of safety of nearly 1.7.

If the resistance to sliding, as found, is not sufficient for safety, a key may be constructed at the base, or the wall continued a foot or more below the ground surface.

Shear

In a wall of this type, the possibility of dangerous shearing stresses are very remote. In reinforced concrete walls, having comparatively thin sections, shear must be considered, and will be discussed in connection with such walls in a later article.

Surcharged Walls

If the fill slopes up behind the retaining wall, or if a load must be carried on the fill behind the wall, allowance must be made for the increased pressure on the wall. The formula giving pressure against a wall having a surcharge sloping at the angle of repose, Φ, is, for a wall with a vertical back:

$$P = \tfrac{1}{2}\ wh^2 \operatorname{Cos} \Phi$$

and for a wall with a sloping back:

$$P = \tfrac{1}{2}\ w\ (h + h_1)^2 \operatorname{Cos} \Phi$$

where h is the height of the wall and h_1 is the height or rise of the surcharge above the top of the wall at a point vertically above the heel of the wall.

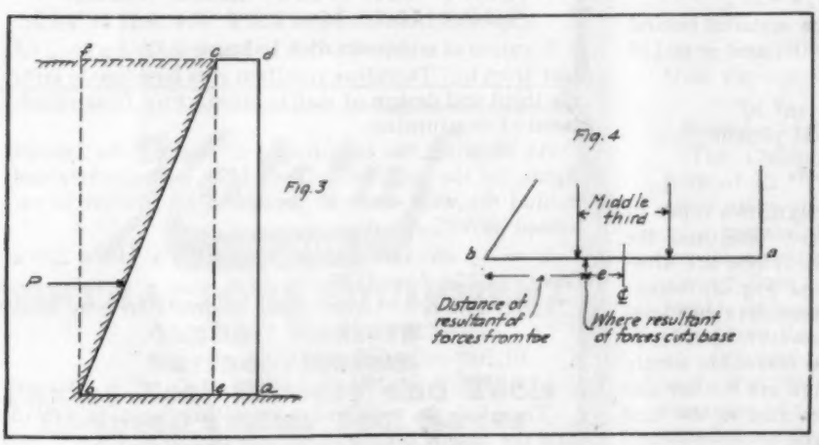
When the surcharge is at an angle x, which is less than the angle of repose, the pressure is, for a wall with a vertical back:

$$P = \tfrac{1}{2}\ wh^2 \operatorname{Cos} x \frac{\operatorname{Cos} x - \sqrt{\operatorname{Cos}^2 x - \operatorname{Cos}^2 \Phi}}{\operatorname{Cos} x + \sqrt{\operatorname{Cos}^2 x - \operatorname{Cos}^2 \Phi}}$$

In all these cases, the pressure P is applied to the rear of the wall at the angle of repose, and is therefore divisible into Ph and Pv.

$$Ph = P \operatorname{Cos} \Phi \text{ and } Pv = P \operatorname{Sin} \Phi$$

The general methods of design, once P is calculated, are essentially the same as for the gravity wall without surcharge.



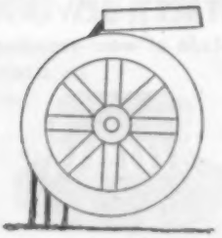
Sanitary Improvements in New York State

According to the State Department of Health of New York, the depression has not shut off (though it may have curtailed) sanitary improvements in the small communities of that state. Cooperstown on last fall put into operation a sewage treatment plant costing $34,000 and including a circular Imhoff tank, two open sludge beds and chlorinating equipment. Newark has remodeled its sewage works at a cost of $100,000, changing an old settling tank into a sludge digestion tank, old sprinkling filters into covered sludge drying beds, and the old secondary settling into a sludge storage tank; while additional units provide for separate sludge digestion and the activated sludge process. Glenn Holmes was consulting engineer.

The taxpayers of Goshen also voted 365 to 71 for a bond issue of $155,000 for additions and improvements to the public water supply, which will include constructing a new impounding reservoir and the installation of a filtration plant to treat the entire supply.

The state commissioner of health has approved plans to treat the milk wastes from a separating and milk powder plant at Lisbon; which will be applied directly to trickling filters 50 ft. diameter and 10 ft. deep by a rotating distributor, the effluent to pass through a settling tank. This will be the first milk waste plant in the state to use this type of distributor.

THE WATER WHEEL



FOLLOWING are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.

EXCLUDING salt water from wells is a problem of peculiar importance in the Bahama Islands, in which underground water must furnish most of the supply. It has been studied and a theory developed by the engineer in charge of water development of Nassau.[4] He estimates that one-third of the rainfall is available for use by wells, and if such use exceeds this amount temporarily (it can not do so continuously), since there is no other source of supply of fresh water and the ground water level is fixed by the hydrostatic pressure from the sea, salt water rises to take the place of the fresh, a salt water cone forming under each well. The greater the number of wells used for withdrawing a given amount of water, the less the height of the salt water cones, and consequently the greater the amount of fresh water that can be withdrawn before salt water rises to the well.

In calculating the amount of safe pumping, he considers the rainfall on only the area covered by the wells and a strip 150 ft. wide around this area; assuming, apparently, that there is no lateral motion toward the wells from outside this area. This idea has been advanced by Miller-Brownlie and Horton,[29] it being "assumed that the *supply of the well* is ultimately derived entirely from infiltration above the area covered by the cone of influence, whereas in the usual method of treatment heretofore, it is assumed that the well is supplied by water flowing into the cone of influence around the periphery of this cone, and infiltration on the area of influence is neglected."

Service pipes of different kinds of material have received an extensive try-out by the California Water Service Co.,[36] whose operations cover practically the entire Pacific coast from 70 miles north of Seattle to 20 miles south of Los Angeles, including both hard and soft waters, and which maintains more than 90,000 services. Since 1928 it has been installing equal amounts of lead-lined galvanized steel pipe and seamless copper tubing for ¾" and 1", and using cast iron for all over 1", with precalked lead joints for 1¼" and 2" sizes. After two years' trial copper was selected in preference to lead-lined pipe, and about 6,000 such services have been installed. Mr. Harris described in his paper, in considerable detail, the installation methods which he had found most satisfactory, including boring instead of digging trenches for long services. "The cost of the copper service is about 20 per cent more than for galvanized steel. However, we believe that its longer life and freedom from tuberculation will justify the extra cost many times. . . . After three and one-half years' use of copper tubing and cast iron pipe for all services, we believe that these are the best and most modern materials now available for making service installations."

Corrosion of mains is a serious matter, the loss caused by it being "estimated at between 50 and 100 million dollars annually."[13] Mr. Downer, after discussing causes and preventives of corrosion, gives the following conclusions:

Metal protected from moisture cannot corrode.

Chrome nickel up to 15% alloyed with iron or steel prevents rust in water, air or acids, but this is too expensive for ordinary use.

Copper up to 0.2% increases the life of metal sheets 2 to 5 times when exposed to the atmosphere but is of doubtful value under water or in soil.

Zinc galvanizing affords little protection underground.

Copper service pipes should be used for all small sizes except for inactive waters and well drained soil.

Lead paint offers good protection in the atmosphere but is of little value in water. Carbon paint should never be used as a first coat but only as a finish coat.

Tar dips applied evenly offer good protection for many years but are not permanent.

Heavy centrifugal linings of cement or bitumens are most effective in permanently preventing corrosion. Bitumastic and

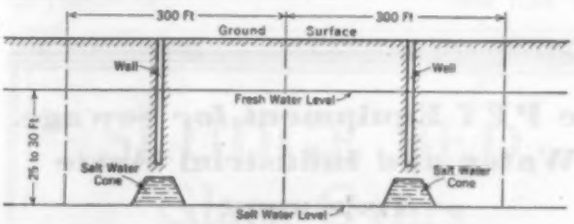


FIG. 4. SALT WATER CONES FORMING UNDER WELLS THAT DO NOT EXTEND DOWN TO SALT WATER LEVEL

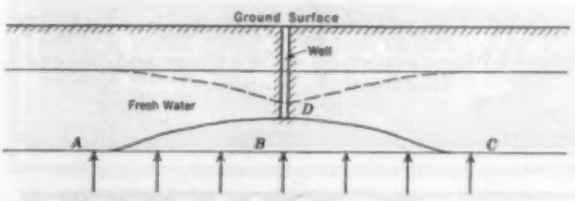


FIG. 5. SALT WATER RISING INTO A WELL ABOVE THE SALT WATER LEVEL

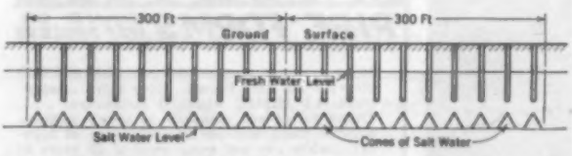


FIG. 6. EFFECT OF CLOSE SPACING OF WELLS ON YIELD OF FRESH WATER

From "Excluding Salt Water from Island Wells," in Civil Engineering for July.

Talbot linings are very resistant to actively corrosive waters and produce the highest carrying capacity of any pipe. Cement lining is subject to attack by carbon dioxide in the water which may dissolve the calcium carbonate in the cement.

Groundings of electric light, power and telephone wires to water pipes should not be permitted.

Pipe lines near railway, high tension transmission lines or power houses should be laid with frequent insulating joints.

Pipes of different metals used in the same line should be separated with a lead gasket and protected with a coat of asphaltum.

Tuberculation is often caused by iron-gathering bacteria which attach to an exposed iron surface. Complete protection of the surface will prevent tuberculation.

Cleaning water mains affords only temporary relief from tuberculation and only accelerates second formation worse than the first.

Alkalimity inhibits corrosion and acidity promotes corrosion. Corrosion of active water may be prevented by the addition of lime to yield a pH value of about 8.0.

Purification may cause corrosion,[37] since it usually depends largely upon the formation of a floc produced by a chemical reaction, or the absorption powers of certain chemicals, or other changes of the chemical combinations in the raw water; and these changes will leave in the water compounds of a caustic or corrosive nature unless they are neutralized. "In general, the pH control and calcium carbonate control will guide the operator in retarding or preventing corrosion. . . . Practically all potable waters, or water that can be rendered potable by purification processes, which are used for public water supplies are more or less corrosive. . . . By a proper chemical balance, an adjustment of the pH value, and the use of some supersaturation of calcium carbonate, the interior of a pipe system can be lined with a corrosion-proof protection of carbonate film."

Well water at Fort Valley, Ga.,[28] containing 0.56 ppm of iron and 45 ppm of free carbon dioxide was so corrosive that corrosion and the iron carried by the water caused a loss estimated at $10,000 a year, or $2 per capita, based on cost of pipe and meter replacements, loss by laundries, steam plants and in manufactured products, and plumbing replacement costs. Limited aeration was tried and greatly reduced the objectionable features, and a plant was built comprising sedimentation basin, mixing flume, decarbonator, aerator and chlorinator; and the iron is now reduced to a trace and the free CO_2 to 3 ppm without the use of chemical, and both to 0 with the use of lime hydrate. Also the pH is increased from 5.2 to 7.1 without lime and 8.4 with lime.

Remote control of the low-service pumps was provided for the new Erie, Pa.,[32] water works plant. A push button on a control table in the high service station throws into operation a vacuum pump which primes a low service pump, the vacuum being recorded on a dial in front of the operator, and the pump is automatically thrown into service when primed and the vacuum pump shut down. The ammeter shows the increased flow of current when the vacuum pump runs and the further increase when the low-service pump starts. Also a venturi meter indicator tells that water is being pumped. Signal lights indicate which pumps are running, and an ampliphone permits the operator to tell, by the sounds, when the vacuum pump starts and stops, when the low service pump starts, and whether everything is working satisfactorily.

Flocculation of the Colorado river water at Boulder City was found impossible last August,[40] although lime, soda ash, alum and other chemicals were tried. More than 80,000 ppm of suspended solids, much of it colloidal, resisted sedimentation, even for 7½ hours, and most of it went to the filters, and much of it passed through; yet the runs were reduced to half-hour and

more water was used to wash the filters than passed through them. Finally Messrs. Forrester and Kelly obtained satisfactory results by dosing with lime, which removed 55%; then with sufficient lime to produce a hydroxide content of over 250 ppm in the effluent from the clarifier but with negligible floc formation, following which the addition of a heavy dose of CO_2 resulted in a heavy calcium carbonate floc formation of 5.5 ft. per hour settling rate, which was extremely efficient in sweeping down the colloidal material and gave a clear overflow; a slight dose of alum just ahead of the secondary mixers expediting the removal of the very fine material.

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c, Indicates construction article; *n*, note or short article; *t*, technical article.

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1. Pasadena Builds Pine Canyon Dam. By Samuel B. Morris, pp. 309-313.
2. *t.* Translatory Waves in Open Channels. By Horace W. King, pp. 319-321.
3. Temiscouata Storage Dam on Sand Foundation. By Jasper H. Ings, pp. 322-325.

July

4. Excluding Salt Water from Island Wells. By J. Ormond Riddel, pp. 383-385.

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5. Mountain Water by Gravity. By James P. Wells, pp. 630-632.
6. Disease-Spreading Plumbing Installations. By Nathan N. Wolpert, p. 633.

July 12.

7. Disease-Spreading Plumbing Installations. By Nathan N. Wolpert, pp. 678-680.

Water Works and Sewerage, July.

8. Milwaukee 6,000,000-Gallon Water Storage Tank. By Herbert H. Brown, pp. 237-240.
9. Attrition Loss of Anthracite in Rapid Filters. By Homer G. Turner and George H. Young, p. 246.
10. Maintenance of Water Meters—Reading and Billing. By J. S. Strohmeyer, pp. 267-269.
11. Observation Station for Finished Water Reservoir. By Carl Leipold, p. 270.

The Surveyor, June 30.

12. Water Supply in Anglesey, pp. 667-668.

Journal, American Water Works Association, May.

13. Protective Treatment of Ferrous Pipe. By Thomas B. Downer, pp. 605-632.
14. Utility Distribution Systems in Housing Projects. By Nathan B. Jacobs, pp. 633-644.
15. Quality of Water and Soap Consumption. By Hersel Wendell Hudson, pp. 645-654.
16. The History of Manganese in Water Supplies and Methods for its Removal. By Carl Zapffe, pp. 655-676.
17. Canadian Experiences in Controlling Tastes and Odors: Taste and Odor Control in Water Supplies. By A. V. De Laporte, pp. 677-679.
18. Removal of Taste and Odor from Municipal Water Supplies. By D. H. Matheson, pp. 680-682.
19. Elimination of Tastes in the Water Supply at Wallaceburg. By J. E. Caughey, pp. 683-685.
20. Experience with Taste in Water at Guelph. By H. S. Nicklin, pp. 691-694.
21. Activated Carbon at New Toronto. By A. H. R. Thomas, pp. 689-690.
22. Chlorine Treatment at the Chatham Filtration Plant. By J. W. Mustard, pp. 686-688.
23. The Oxidation Potential Concept of Chlorination. By F. C. Schmelkes, pp. 695-703.
24. The Water Supply System at Appleton, Wis. By Wm. U. Gallaher, pp. 704-710.
25. Operation Experience at the Cedar Rapids Water Purification Plant. By H. F. Blomquist, pp. 711-717.
26. The Use of Anthracite Coal as a Filter Medium. By Michael A. Farrell, pp. 718-724.
27. Impairments in Fire Protection and their Causes. By Lawrence Daw, pp. 725-727.
28. Water Supply Improvements at Fort Valley, Ga. By T. A. Jones, pp. 728-733.
29. The True Significance of Drawdown in Wells. By Howard O. Williams, pp. 734-739.
30. The Chemical and Biological Characteristics of Pacific Northwest Waters. By H. W. Nightingale, pp. 740-746.
31. Nomenclature for Treatment Devices. By Edward S. Hopkins, pp. 747-748.

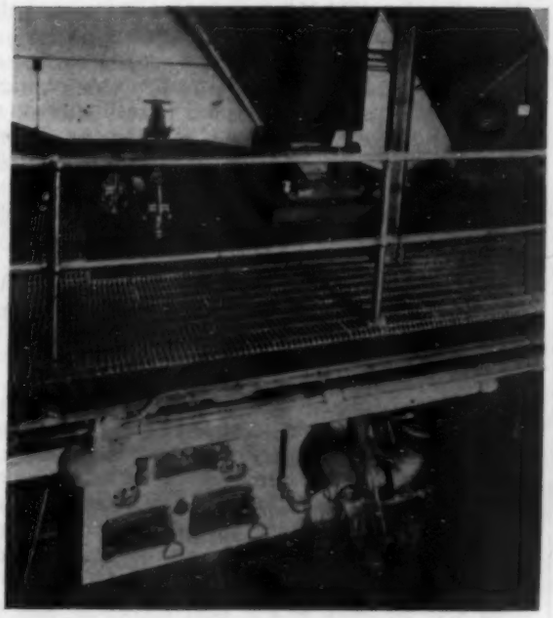
June

32. New Auxiliary Water Plant at Erie, Pa. By J. T. Campbell, pp. 771-778.
33. Meter Reading. By George H. Fenkell, pp. 779-792.
34. Regulation of the Colorado River. By C. C. Elder, pp. 793-802.
35. Water Production Measurement Methods. By L. Standish Hall, pp. 803-809.
36. Modern Service Installations. By H. A. Harris, pp. 810-817.
37. Corrosion Following Water Purification Processes. By Chester A. Smith, pp. 818-821.
38. Office Practice in the Winston-Salem Water and Sewer Department. By R. L. Dixon, pp. 822-831.
39. Pumping Station and Filtration Plant at St. Joseph, Mich. By F. G. Gordon, pp. 832-837.

(Continued on page 40)

Do you make full use of the Readers' Service Dept.?—see pp. 47-50

Sludge Disposal by Incineration



Decarie water-jacketed screenings incinerator, South Yonkers, N. Y., sewage plant.

By M. J. Blew

ATTEMPTS to dispose of sewage sludge economically and satisfactorily by incineration have been made for years. The many advantages to be obtained through disposal by this means include: Saving in capital cost through the elimination of sludge drying beds and, when fresh sludge is incinerated, digestion tanks; elimination of nuisance; great reduction in volume of resulting waste to be handled; and the lesser space required for an installation. Operating costs may or may not be greater.

The difficulties to be solved have hinged on such factors as the very high moisture content of the sludge, the variation in the physical characteristics and calorific value of the various sludges; the possibility of creating odors; and the production of clinker at high temperatures. With the development of various methods of, and equipment for, dewatering sludge rapidly and economically, disposal by incineration promises much for the near future.

The Heat Value of Sludge and Screenings

The calorific value of sludge varies with its combustible content. Sludge from separate systems is higher in heat content that that from combined systems; and in combined systems, the sludge deposited after storms is apt to be lower in heat values than that produced by dry weather flows, because of the large amount of grit or other inert material carried in storm water. That produced by activated sludge plants is also high in heat value.

Domestic sludges run as high as 9,000 to 9,500 Btu per pound of dry solids, which is as high as some low-grade coals. Combined sludges, undigested, average a little under 6,000 Btu, though sometimes running as high as 7,000. Sludge from digestion tanks is lower in thermal value because of the loss in volatiles in the formation of methane and carbon dioxide, averaging about 4,000 Btu per pound of dry solids. After drying and leaching on sand beds and spoil tanks, there is a further loss in heat value.

THERMAL DATA ON SLUDGES

Source of	*Btu. Per Pound of Dry Solids*
Fresh sludge (combined system)	6,380
Imhoff sludge, combined system, sand beds	3,500
Fresh domestic sludge, Lakewood, N. J.	9,000
Domestic sludge from sand beds	6,000
Scum, separate digestion tank	6,800 to 9,000
Secondary tank sludge, Plainfield, N. J.	7,500
Domestic sludge, separate digestion	7,500
Imhoff tank sludge, Philadelphia	4,686
Detritus from grit channel	1,900 to 3,400
Fresh sludge, Palmyra, N. J.	9,100
Scum	9,600

Fine screenings possess from 2,000 to 3,000 Btu per pound of dry solids (Ed. Note: Milwaukee experiments have shown much more than this—in fact, up to 10,000 Btu). Coarse screenings may run above or below these figures, due to such factors as the size of the screen, maintenance of the sewer system, etc. Scum from settling tanks contains considerable soap and grease and has a high test content. Several samples have shown values from 8,500 to 9,600 Btu per pound of dry solids.

Oil-fired furnace burning 65 pounds per hour of coarse screenings, at Reading, Pa., by the Morse-Boulger Co.

Moisture Content and Temperature

The moisture content in sludge is so great as to require the use of additional fuel unless the sludge has been dewatered previously. Under the most favorable conditions, sludge with a moisture content of 75% has been found to be self-sustaining; it is therefore desirable to dewater to this point or, preferably, lower.

To prevent odors, incineration must be carried on at temperatures above 1400°F; temperatures as high as 1800°F are preferable. Clinkers are produced, when much sand is present in the sludge, at heats greater than about 2000°F. Ordinarily at temperatures of 1400°F the ash is a red-brown color and very fine, 95% of it passing a 200-mesh screen. It contains from 0.5% to 4% volatile matter when the grates are properly operated.

When ash fuses into clinkers, the air supply is reduced and incineration impeded. The clinker is tough and tenacious and difficult to free from the grate bars, for which reason moving grates are desirable.

Incineration

The plant should be so arranged that the storage of sludge should be for as short a period as possible. The sludge should be dewatered and pre-dried before reaching the combustion chamber, and combustion should be complete in a refractory lined chamber. The removal of ash and clinker should be automatic. A secondary combustion chamber should be provided to complete the destruction of the gases from the drying chamber. Forced draft should be available, and it is desirable to have the air preheated to 300 or 400 degrees. Special attention must be paid to provisions for so admitting the wet sludge that it will not blanket the fire.

The Water Wheel

(Continued from page 37)

40. Water Softening at Boulder City. By Earl M. Kelly, pp. 838-846.
41. Beautification of Water Works Properties. By Wm. W. Hurlbut, pp. 847-850.
42. Chlorine Tolerant Bacteria in Water Supplies. By David B. Charlton, pp. 851-854.
43. Dominick-Lauter Medium Compared with Standard Lactose Broth for B. Coli Tests. By H. V. Stewart, pp. 855-858.
44. The Ammonia-Chlorine Process in St. Cloud, Minn., B. C. L. Ehrhart, pp. 859-866.
45. The Most Probable Numbers of B. Coli in Water Analysis. By J. K. Hoskins, pp. 867-877.
46. Water Hammer. Brief synopses of symposium papers, pp. 878-884.

Engineering News-Record, June 29

47. Sewers and Water Mains Laid by Relief Labor. By L. M. Bush, pp. 832-833.

July 6

48. Sacramento Sets New Standards in Pre-Treatment. By Harry N. Jenks, pp. 1-5.
49. Difficult Caisson Sinking for Vancouver Water Tunnel. By William Smaill and R. M. Wynne-Edwards, pp. 9-11.

July 13

50. Non-Slip Hydraulic-Fill Dam for San Diego. By H. N. Savage, pp. 33-36.

July 20

51. Redesign and Construction of Prettyboy Dam, pp. 63-67.

The Canadian Engineer, July 4.

52. Water Treatment for Industrial Purposes. By J. O. Meadows, pp. 10-11.

July 11

53. *t.* Construction of a Large Reinforced Concrete Wash-Water Tank. By H. B. Dickens, pp. 5-8, 10.

July 18

54. New Pumping Station and Reservoir at Winnipeg. By H. N. Holland, pp. 11-14.
55. Softening of Municipal Water Supplies. By W. H. Walker, pp. 15-18.

Johnson National Drillers' Journal, June-July.

56. The Problem of Corrosion of Well Screens. By Howard O. Williams, pp. 1-3.
57. Reducing the Flow of Artesian Wells. By Howard E. Simpson, p. 5.

The Water Tower, July.

58. Lindsay, Ont., Improves Water Services and Reduces Operating Costs with Elevated Tank, p. 7.

American City, July.

59. Pumps and Their Places. By L. R. Douglass, pp. 41-43.
60. Water Softening Plants for Small Cities. By Howard R. Green, pp. 49-51.

Studies in Compaction of Earth Fills

Compaction of earth fills as affected by type and size of haulage and other equipment has been the subject of investigation of a special committee of the American Road Builders' Association, of which the chairman is J. T. Ellison, chief engineer of the Minnesota Dep't of Highways. This committee reported to the 1933 convention that some rolling tests had been carried on by the Buffalo-Springfield Roller Co., which it described as follows:

High Compression

A strong box was built having inside dimensions of 36″x21″ by 12″ deep. The box was buried in the ground with the upper edges of the walls flush with the surface. The box was filled with loamy clay mixed with fine gravel. The material was rolled with the wheel of a ten ton roller that was equipped with a scarifier giving a compression of 429 pounds per linear inch of width. The roll was 69 inches in diameter and 20 inches wide.

The first slow passage of the roller resulted in a shrinkage in the depth of the material of 1½ inches; the second passage increased the shrinkage by ⅜ inch; and the third passage increased the shrinkage by ¼ inch, making a total of 2⅛ inches or 17.7 per cent.

The experiment was repeated except that the speed of the roller was increased to high. The result of the first passage was a shrinkage of one inch, of the second passage ¼ inch, and the third passage resulted in no further shrinkage. The total for the fast speed was 1¼ inches or 10.4 per cent.

The experiment was repeated with fine gravel rolled in 4-inch layers in slow speed. The resulting shrinkage from a 16-inch depth was 4 inches or 25 per cent, bringing the weight of the material from 107 pounds per cubic foot to 143 pounds per cubic foot.

Low Compression

Light compression was obtained by piling flat weights on the surface of the loose material with which the box was filled. The compression was 8 pounds per square inch. The shrinkage in depth was ⅜ inch or 3 per cent for the fine, loose gravel, and 11/16 inch or 5.7 per cent for the loamy clay and gravel mixture.

From these tests the following conclusions appear justified:

1. The time lag of material under pressure is considerable.

2. The actual movement of soil particles depends on speed, and also on traction reaction and side support of material.

3. The lack of compaction under high speed is due both to soil lag and the traction shear that turns the resultant of the forces from the vertical toward the horizontal.

Relative Value of Cement Mixer 50 Days in Use

The selling price of a cement mixer which has been in use 50 days before its conversion furnishes no safe measure of its value at the time of conversion, as such machinery degenerates rapidly under use. Samford v. Young Road Machinery Co., Alabama Supreme Court, 124 So. 880.

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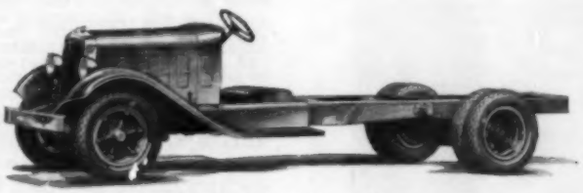
Do you make full use of the Readers' Service Dept.?—see pp. 47-50

New Equipment

Trucks—Garbage Disposal—Pipe Joints and Tools

Three New Federal Motor Trucks

The production of three new six-cylinder trucks has been announced by the Federal Motor Truck Company, Detroit, Mich. These new chassis, designated as 15A, 20A and 25A, are rated at 1½-ton, 2-ton and 2½-ton respectively. The 1½-ton chassis is priced at $695 for the standard wheelbase. The standard wheelbase 2-ton chassis sells for $1095 and the 2½-ton for $1395.



Federal 15A 1½-ton chassis

The outstanding characteristic of these new trucks is their unusually strong and substantial construction. An idea of the great margin of safety that is built into them may be gained from the frames which have a maximum depth of 8½". It is also evidenced by the chassis weights (standard short wheelbase), which are 3500 lbs. for the 1½-ton, 3900 for the 2-ton and 4500 for the 2½-ton. They are equipped with 6-cylinder, 7-bearing truck engines.

For Cutting and Swedging Soft Copper Tubing

H. W. Clark Co., Mattoon, Ill., have devised a new outfit, shown herewith, for use with ¾" and 1" soft copper tubing. It is guaranteed to make a square right angle cut and to secure the proper bevel and size on the tube.

Jeffrey Green Garbage Grinder

As an advanced step in securing satisfactory garbage disposal with a minimum of effort and expense, The Jeffrey Manufacturing Company, Columbus, Ohio, has recently developed the Jeffrey Green Garbage Grinder, a cross-section of which is illustrated here.

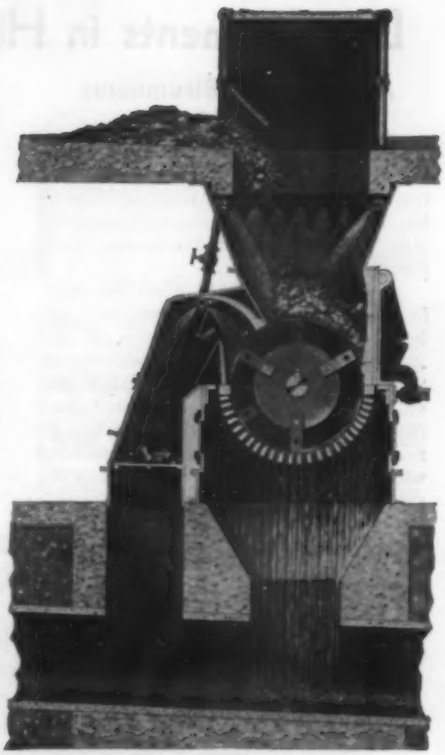
In this new machine, garbage is ground to a finely divided pulp and the pulped garbage is passed on to discharge into the local sewerage system or into a stream.

Green garbage contains 50% to 90% of moisture, which is released as free water by the beating and reducing process of the Jeffrey Grinder. Water thus released insures free movement of the garbage through the sewerage system.

In operation, garbage is dumped on a sloping concrete floor from collection trucks. Sorters pick out tin cans, brick bats, silverware, etc., and then push the garbage through the hinged doors and into the grinder. Water from spray pipes installed in the feed hopper above the grinder flushes the reduced garbage through the grinder and into the sewer.

Provision is made in the machine to take care of any inorganic material overlooked by the sorters. This material is forced into a trap at the back of the grinder, while water from a spray pipe in this trap passes through the bar grating at the bottom where the material lodges. This inorganic material is occationally raked out through a hinged door at the back.

The recovery of silver and other reclaimable material represents quite an item of income and helps pay the operating cost of the plant in many cases.



Jeffrey Garbage Grinder

The plant required for the grinding of green garbage can be small and very inexpensive. A small town can install one unit with a small investment, while in larger cities a number of these small plants can be conveniently located in different sections, thus eliminating long hauls. The grinding plants can be kept odorless by flushing with water. The cost per ton for grinding the garbage is very low, since there is only the grinder and its motor to maintain, and unskilled labor can successfully operate the plants.

Full information can be obtained from the Jeffrey Mfg. Co., Columbus, O.

A Runner for Making Perfect Pipe Joints

A new type of runner, which it is claimed will make perfect water main joints, is heat treated so as to remain unaffected by temperatures up to 1800° F. This runner is said to be instantly adjustable to fit various sizes of pipe, gives a snug fit and is instantly released after the joint is poured. It is made by Geo. E. Williams, 3 East 26th St., Minneapolis, Minn., who will send a folder on request.

LEFT: *Clark outfit for cutting and swedging copper tubing.* RIGHT: *The Williams joint runner.*

Developments in Highway Equipment

Austin Junior Bituminous Distributor

An improved series of bituminous distributors for mounting on a light truck chassis, such as a Ford or Chevrolet, has just been announced by The Austin-Western Road Machinery Company.

In the design of this Junior line, offering capacities of 400, 500 and 600 gallons, all the desirable features of the Austin larger units have been maintained. For example: pump, piping, and valves are enclosed in insulated heat chambers; a water-cooled engine is used to drive the pump; the pump is provided with a cored jacket, through which the exhaust from the power unit is piped; and the exhaust is also piped to the rear, where it is used for heating and blowing out the spray system.

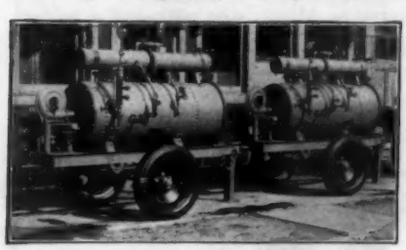
Austin Small Bituminous Distributor

Speeding Up the Heating of Bituminous Materials

Information from Cleaver - Brooks Co., Milwaukee, Wis., shows some fast and economical work in heating and handling bituminous materials. One user, for example, heated and unloaded 110,000 gallons of oil in one working day with a No. 2 Cleaver Booster. During the season just past, another Booster unit heated approximately 175 cars. Another user, with one car heating unit and two boosters, heated approximately 3,000,000 gallons of road oil last season.

These Cleaver Tank Car Heaters are portable units, mounted on both trailers and trucks. They are built in four sizes. Although designed primarily for heating tank cars of bituminous materials to pumpable tempertaures, they are used also for thawing out culverts and manholes, and for steam cleaning machinery and trucks.

Among their advantages is rapid steaming. From a cold water start, they develop full working steam pressure in 30 minutes. Other features are high efficiency, portability, low fuel costs, no waste of condensate, rapid heating, low maintenance costs and controlled heating capacity.

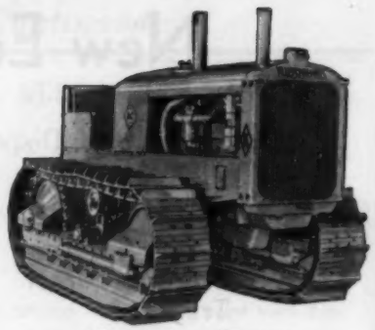


Cleaver-Brooks Heater

A New A-C Tractor

The new Model "K" Allis-Chalmers tractor develops a maximum of 48 drawbar horsepower and has a top speed of 4.50 miles per hour. At 2.08 miles an hour the "K" develops 8,750 drawbar pounds pull. The 15" track shoes give a total of 2,010 square inches of track surface in contact with the ground, providing ample traction to hold the extra power. The "K" weighs approximately 11,000 pounds, giving a ground pressure per square inch of 5.27.

In addition to the new power and speed, the drawbar has been specifically designed to withstand the load of a direct hitch 7 or 8-yard wagon. This drawbar also has a wide swing which materially lessens the side draft when pulling a blade grader.



Allis-Chalmers Tractor

Motor Truck Concrete Mixers

The Chain Belt Company, by constant development work, has opened up new fields for truck mixers. Through the Jackass Hoist concrete can be chuted over an area approximately 75% greater than with ordinary truck mixers. Sidewalks can be poured across parkways without wheeling, and building foundations and walls can be chuted even when the truck cannot get within 10 to 20 feet of the hole. This type of mixer is particularly applicable to the small paving and sidewalk jobs, and practically all alleys and some streets can be "fanned" their full width.

The One-Man Spout permits one man to swing it out into position and ready to pour in less than one minute. It is balanced and so light that a man can handle it with one hand.

The low center of gravity of the Rex makes it a very roadable machine. Other important features include the certified mixing action, accompanied by extra large impellers and blades to handle any type concrete; accurate water; leak proof discharge; light weight; and easy control.

Rex Moto-Mixers are made in 1, 1½, 2, 3, 4 and 5-yd. units, and the Moto-Agitator (Moto-Mixer without water system) is furnished in 1½, 2, 3, 4½, 5 and 7-yd. sizes.

Chain Belt Truck-Mixer laying sidewalk

Readers' Service Department

To help you in your work, any of this **INDUSTRIAL LITERATURE** will be sent **FREE** upon request.

It is a good practice to check this list regularly because descriptions of new bulletins are always being added. ★

Construction Materials and Equipment

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Mixing Plants

10. Precise engineering control of bituminous pavement construction is provided at low initial cost by the new Blaw-Knox (Madsen) portable asphalt mixing plant which is described and illustrated in a new catalog just issued by Blaw-Knox Company, 2019 Farmers Bank Building, Pittsburgh, Pa.

Asphalt Plants

11. A very complete 24 page booklet covering all five sizes and types of Iroquois Asphalt Mixing Plants which are particularly adapted to meet the needs of municipalities and contractors, providing maximum output at minimum cost. Barber Asphalt Co., 1600 Arch St., Philadelphia, Pa.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size. The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallion Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Graders

76. Latest information about Gallion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Gallion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

78. The No. 101 Austin Leaning Wheel Grader is completely described and illustrated in Bulletin No. 1238 which shows operation of Z-Bar, back sloper, bank cutter, etc. Published by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago.

79. Four new bulletins have just been issued describing and illustrating the Austin No. 77 Motor Grader. Contain construction details, specifications and weights. The Austin-Western Road Mach. Co., 400 N. Michigan Ave., No. A5, Chicago, Ill.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the MacMillan Petroleum Corp., El Dorado, Arkansas.

114. Complete information concerning Alabama Asphaltic Limestone will be sent promptly on request to the Alabama Asphaltic Limestone Co., Liberty National Bldg., Birmingham, Ala.

Road Machinery

126. A new picture book of the Austin-Western Line of road machinery showing the application of road graders, road rollers, elevating graders, crawler and wheeled wagons, crushing and screening plants, shovels, cranes and excavators, scarifiers and many small tools, is contained in Catalog No. 1247. Copies available on request at The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago.

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Road Machinery

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg Co., Galion, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

144. Complete information including operating ranges of General Excavators is given in Bulletin No. 3210 recently prepared by The General Excavator Co., 365 Rose St., Marion, Ohio.

145. The Austin Badger, a new, fully convertible ⅝ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Road and Street Maintenance

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Asphalt Mixing Plants

10. Precise engineering control of bituminous pavement construction is provided at low initial cost by the new Blaw-Knox (Madsen) portable asphalt mixing plant which is described and illustrated in a new catalog just issued by Blaw-Knox Company, 2019 Farmers Bank Building, Pittsburgh, Pa.

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Bituminous Material Handling

201. "Handling Bituminous Road Materials." This is a new and valuable booklet covering handling and heating of bituminous materials for low cost road construction and maintenance. Full data regarding Cleaver-Brooks equipment. Cleaver-Brooks Co., 740 North Plankinton Ave., Milwaukee, Wis.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Surface Heaters

220. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the Macmillan Petroleum Corp., El Dorado, Arkansas.

226. Full details concerning the uses and advantages of Lincolnite Pulverized Petroleum Asphalt, Linco Road Oils, Cutback Asphalt Cement and Penetration Asphalt Cements will be sent free on request by Lincoln Oil Refining Co., Box 251, Robinson, Ill.

227. "Asphalt for Every Purpose, a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K. P." 16 pages, illustrated, 3¼x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

Pennsylvania Sewage Works Association

The Seventh Annual Conference of this association will be held at State College, Pa., September 5, 6 and 7. After registration Tuesday afternoon, the 5th, F. E. Daniels will give a demonstration of and instruction in sewage plant tests. Wednesday morning there will be a "trouble hour," while in the afternoon there will be papers as follows: Operating Experiences in New York State, by C. C. Agar; Excessive Ground Water in a Sewer System and its Effect on Plant Operation, by C. A. Emerson; Application of the Sewer Rental Law, by John L. Fertig, and Experiments on the Heating of Sludge, by E. R. Queer.

H. E. Moses will be the leader at the round table discussion and dinner that evening, and on Thursday morning there will be three papers before adjournment: J. F. Laboon, Sewage Collection and Disposal at Lancaster, Pa.; J. K. Hoskins, The Oxygen Demand Test and Its Application to Sewage Treatment, and E. D. Flynn, The Mechanical De-Watering of Sewage Sludge on Vacuum Filters.

Personal and Engineering Notes:

Wilder M. Rich has been appointed City Manager of Hackensack, N. J. Mr. Rich has formerly been city manager of Sault Ste Marie and Ironwood, Mich., Goldsboro, N. C., and Alexandria, Va.

S. Leland Tolman has joined the engineering staff of the sanitary division of the Jeffrey Mfg. Co., Columbus, O. From 1919 to 1932, Mr. Tolman was with the Sanitary District of Chicago. Previous to that time he was at Mason City, Iowa, in charge of garbage and sewage disposal, and on subway construction in New York. Recently he has been with the J. N. Chester Co., Engineers, Pittsburgh, and was engaged on the design of the sewage treatment works at Lancaster, Pa.

Books and Publications:

Least Squares: "Some elementary examples of least squares" is the title of a publication which can be obtained from the government printing office, Sup't. of Documents, Washington, D. C., for 5 cents cash money, stamps not accepted. This serial, No. 250, discusses some of the fundamental processes, including: examples of determination of maxima and minima with one and two conditions; relation between squares and arithmetic, etc., etc. Some of it sounds slightly familiar and we recommend it highly.

Impervious Brick Masonry: J. F. Nicholl has written one of the most complete texts on the subject that we know of. In addition to presenting procedure and results of tests, Mr. Nicholl, who is engineer of the Alton Brick Co., Alton, Ill., has correlated and condensed a number of articles on this subject. Of these articles, 64 are listed in detail. The booklet contains 72 pages of concise,, sound and valuable data. There are 10 chapters, plus introduction and summary.

Water Supply for the Isolated Home: This is one of the uniformly excellent and valuable publications of the Engineering Extension Service of Iowa State College, Ames. It was written by Lindon J. Murphy, who has done several other of the bulletins issued by this college. The practical way in which usable and matter-of-fact information is presented, and the excellent illustrations accompanying the text lead us to hope that some of these will be copied for use in the bulletins of various state health departments. But we don't care much for the illustration on page 6, even though it is an improvement over most we have seen. The photos on pages 9 and 14 are better.

Bulletins and Booklets:

Hi-Early Portland: A folder and special mimeographed bulletin on Nazareth Cement Co., Nazareth, Pa., high early strength cement. It is said to produce usable concrete in 24 hours.

Road Machinery: The Austin Super-Rugged Model "77" with full dual drive and hydraulic control models; The Austin "77" hand operated full dual drive motor grader; the Austin "77" single drive motor grader with hydraulic controls; and the Austin "77" hand control, single drive motor grader. These are described in bulletins just issued by the Austin Western Road Machinery Co., 400 North Michigan Avenue, Chicago.

Tank Car Heaters: If you want to handle low cost road materials economically and without waste of time, there are Cleaver 1-car and 2-car heaters, and boosters, on trailers, trucks and skids. Cleaver-Brooks Co., 135 W. Wells St., Milwaukee, Wisc.

Hard-Facing Equipment: Increased life and savings effected through the application of hard-facing materials to the wearing parts of excavating and road-building equipment are described in a 16-page bulletin issued by the Haynes Stellite Co., 205 East 42nd St., N. Y.

Link-Belt Co. "Chicago, 1933" is the title of a beautifully arranged 48-page booklet put out by the Link-Belt Co., Chicago, Ill. Free on request on your business letterhead.

Truck and Trailer Sizes and Weights: A handbook compiled by F. M. Higgins of the F. W. D. Co., gives regulations in tabular form covering every state; also total gross loads for all possible truck and trailer combinations. Four Wheel Drive Auto Co., Clintonville, Wisc.

Drafting Room Manual: A 60-page manual, designed like a reference file, with unique self-indexing features, has been published by the Hamilton Manufacturing Co., Two Rivers, Wisc. There are nine sections, each of which will be found of real practical value in laying out drafting rooms, art departments, etc.

News From the Manufacturers:

Waukesha, Motor Co., Waukesha, Wisc., has been granted American rights for Hesselman oil engines and will manufacture a line of heavy oil engines for truck, tractor and general industrial service.

Northwest Engineering Co., has appointed Harmon-Hodge-Hammond, Inc., 1162 Grinnell Place, the Bronx, New York City, as sales agents in southeastern New York.

Coppus Engineering Co., Worcester, Mass., has appointed W. S. Gain, 418 Lafayette Bldg., Buffalo, N. Y., to handle its lines of filter equipment in that territory.

The St. Louis office of the Chain Belt Co., Milwaukee, Wisc., has been moved to 5475 Cabanne Ave., from the old address, 339 No. Taylor Ave.

Industrial Sales & Chemical Co., N. Y., have opened a branch office for handling Nuchar activated carbon at 370 West Broad St., Columbus, O., with Richard N. Statham in charge.

Chapman Valve Co., Indian Orchard, Mass., has been given the exclusive right and license to manufacture and sell all products heretofore manufactured by the Automatic Cone Valve Co., Matton, Ill.

The Norwood Engineering Co., Florence, Mass., has been awarded the contract for four 1-million gallon filter units for the city of Fargo, N. D. These units represent an addition to the original plant, which was also constructed by the Norwood Engineering Co.

Flow Meter: A data book on an exceptionally accurate, straight line flow meter. Published by, and sent free on request to, the Isometer Co., Elgin, Illinois.

Index to Advertisements

Snow Removal

Snow Fences

344. "Control Winter Drifts"—A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Peoria, Ill. Illustrated in two colors.

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 400 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

381. Proportioneer's Inc., 737 N. Michigan Ave., Chicago, describe in an 8 page folder their mechanical devices for controlling accurately and automatically the flow of fluids used for treatment of water supply and sewage. Ferr-O-Feeder —diaphragm pump for Ferric-Chloride or other corrosive fluids; Chlor-O-Feeder for Hypochlorate solutions. Write for a free copy.

Ferric Chloride

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Glass-Overs

393. Full details regarding the use of Lord & Burnham Glass-Covers at Dayton, Ohio; Highland Park, Ill.; Fostoria, Ohio; and Bloomington, Ill., are given in bulletins Nos. 10, 11, 14, 15. Issued by Lord & Burnham, Irvington, N. Y.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Meters, Sewage and Water

405. Just issued. Every sanitary engineer should have a copy of this new 32 page booklet describing the applications, types and distinctive features of the new Bailey meters for sewage treatment and water supply. Sent promptly. Bailey Meter Co., 1027 Ivanhoe Road, Cleveland, Ohio.

Pipe Forms

407. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

381. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

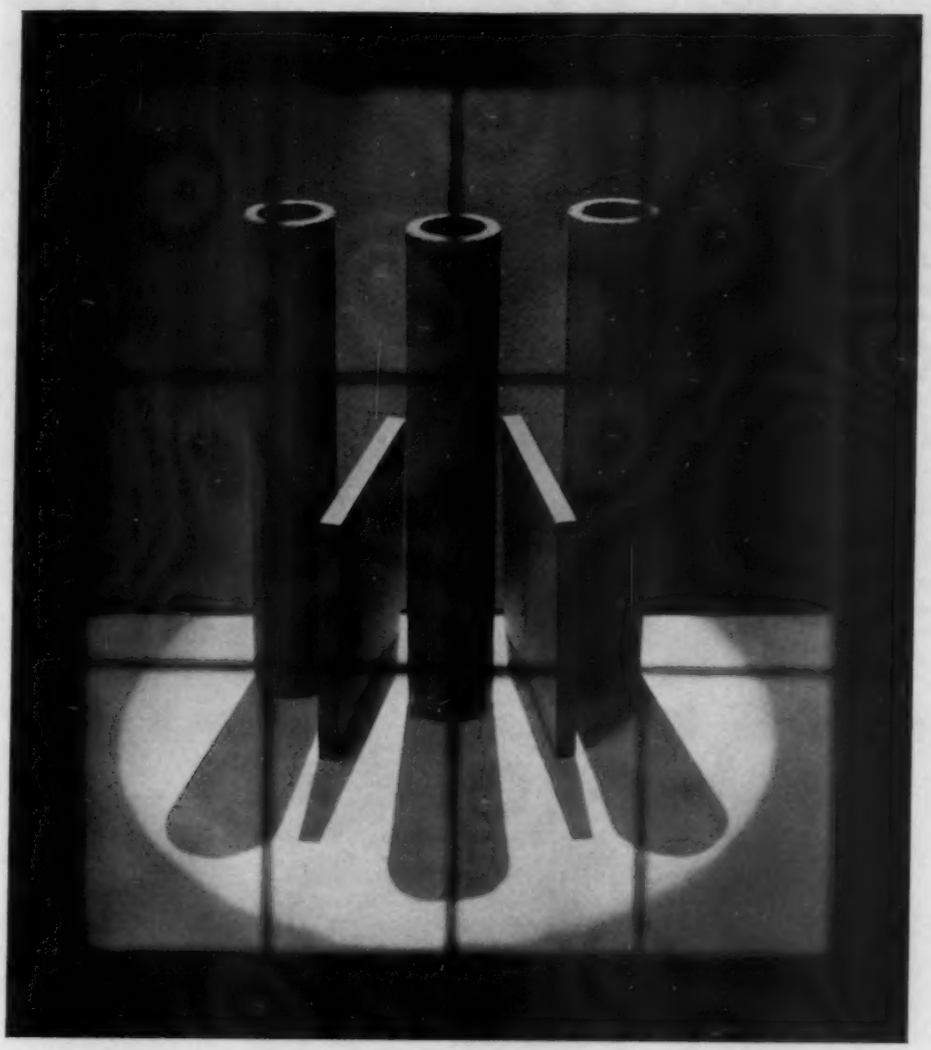
Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcomes these problems will be sent to all interested by Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.



Time-Tested Porous Mediums—

Norton Plates and Tubes

THE performance of Norton Porous Mediums has been proved by many years of service in plants from the Atlantic to the Pacific, from the Great Lakes to the Rio Grande.

During the whole period that Norton Plates and Tubes have been in active use Norton engineers have kept in close contact with disposal plant operations—are fully posted on all the problems and developments in modern sewage purification.

Because of their proved performance, because of the experience of Norton engineers and because of the careful control in the manufacture and testing of Norton Porous Mediums they are becoming more and more widely used —are standard in many plants.

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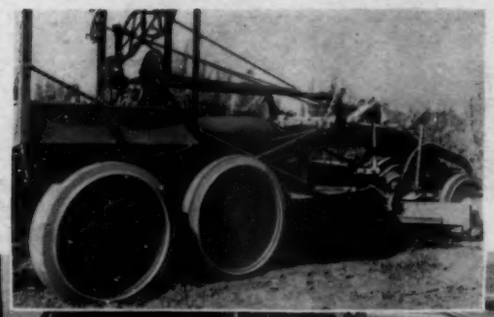
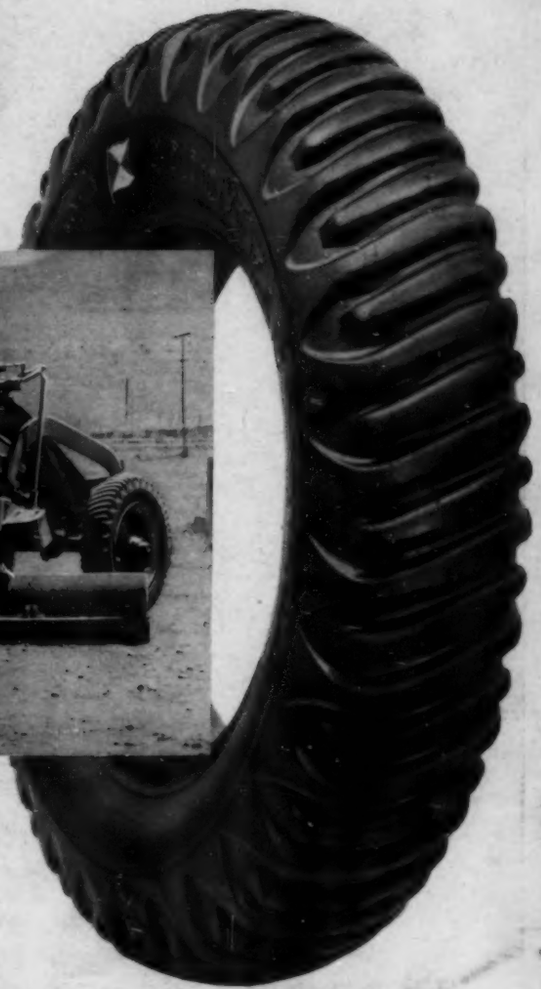


Old grader on solid tires. Speed limited—traction uncertain.

Same grader, changed to Goodyear Pneumatic Lug Tractor Tires. Work speeds up—no-slip, go-ahead traction.



What a DIFFERENCE

when you change over to

GOODYEAR *Pneumatic* LUG *Tractor Tires*

SAN BENITO COUNTY, California, wanted three new road graders but had money for only one.

"Let's overhaul one of the graders, rip off those solid tires and put on the Goodyear lug-type pneumatics we've been hearing so much about," said Fred Penna, Superintendent of Equipment. "Maybe that's our solution."

Goodyear cut down the wheels and put on the new tires. Result—the grader covered so much more ground in a day that the two other machines were also changed over to Goodyear Pneumatic Lug Tractor Tires. The county saved several thousand dollars, has three graders practically as good as new.

Put in fewest words, Goodyear Pneumatic Lug Tractor Tires give you more power... more daily coverage... fuel saving up to 20%... saving on repairs. The no-slip, exclusive tread is SELF-CLEANING. The rubber is compounded to resist oil-acid solutions. The carcass is built of long-wearing, heat-resisting Supertwist Cord.

See your tractor and grader dealer for full details. Or write or phone Goodyear Government Sales Department, Akron, Ohio, or Los Angeles, Calif. ACT NOW—BENEFIT THIS SUMMER.

GOODYEAR

SPECIFY GOODYEAR PNEUMATIC LUG TRACTOR TIRES ON NEW GRADERS AND MAINTAINERS